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The Bureau of Mines Minerals Availability System: An Update of Information Circular 8654

By Herbert R. Babitzke, Aldo F. Barsotti, Joseph S. Coffman, Jerrold G. Thompson, and Harold J. Bennett

UNITED STATES DEPARTMENT OF THE INTERIOR

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UNITED STATES DEPARTMENT OF THE INTERIOR
James G. Watt, Secretary

BUREAU OF MINES
Robert C. Horton, Director

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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PREFACE

The Minerals Availability System (MAS) was formally established by the Bureau of Mines in May 1975 to provide current appraisals of the engineering and economic availability of nonfuel minerals for consideration in the formulation of both domestic and foreign minerals policy.

The Bureau of Mines has been involved in both mineral commodity surveys and property evaluations for many decades, although these earlier assessments of minerals availability were generally limited in scope to either specific sites or, at best, domestic occurrences. The Bureau of Mines earlier efforts were summarized in Information Circular 8654, "The Bureau of Mines Minerals Availability System and Resource Classification Manual," published in 1974.

With the advances in data processing technology and through the consolidation of the Bureau's data collection and analysis expertise since the publication of Information Circular 8654, several changes have been made in the system. It has also been expanded to include foreign mineral deposit data. This report summarizes these improvements in the Minerals Availability System.

All publications described in this report are available from the Superintendent of Documents, Washington, D.C. 20402. Requests for MAS data and/or computer programs should be directed to the Division of Minerals Availability, 2401 E Street, N.W., Washington, D.C. 20241.

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ABSTRACT

The Minerals Availability System (MAS) was formally established by the Bureau of Mines in May 1975 to provide current appraisals of the engineering and economic availability of nonfuel minerals for consideration in the formulation of both domestic and foreign minerals policy. Domestic mineral property reports are developed by the Bureau's four Field Operations Centers, and foreign data are obtained under contract. This site-specific information is subsequently subjected to engineering verification and economic evaluation, and the results are analyzed and published as Minerals Availability System Appraisals.

The deposit-specific data are also entered into the computerized MAS data base, where a subset of this information, the Mineral Industry Location System (MILS), is available to the public in the form of computer graphics and listings. Other MAS products are also described.

The Bureau's MAS personnel are frequently involved in special engineering and mineral economic projects for other Federal and State agencies. MAS personnel also work closely with the private sector, both in the area of mining and processing cost estimation, and as a source of nonproprietary mineral deposit information.

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INTRODUCTION

The United States is vulnerable to interruptions in both domestic and foreign minerals supply that could adversely impact its economy. Formulating meaningful minerals policy options requires a comprehensive knowledge of the many factors affecting mineral supply; accurate appraisals of the distribution and availability of the world's mineral resources are essential to such knowledge. Accordingly, the Interior Department's Bureau of Mines, to provide a reliable source of such appraisals, established the Minerals Availability System. This system is designed to measure and classify known domestic and foreign mineral resources according to each deposit's engineering and economic availability. The information is used in the compilation of comprehensive worldwide minerals availability studies. These determinations provide guidance to the development or modification of national minerals policy, and can be of direct benefit to programs concerned with mineral stockpile assessment, minerals exploration, extraction technology research, tax restructuring, substitute material studies, land utilization, etc.

A number of Minerals Availability System overviews, as well as detailed descriptions of portions of the MAS Program, have been published in the past; however, this report provides the first comprehensive description of the overall Bureau of Mines MAS Program.

The Bureau of Mines has been involved in both mineral commodity surveys and property evaluations for many decades, although these earlier assessments of minerals availability were generally limited in scope to either specific sites or, at best, domestic occurrences. The MAS concept, which addresses the importance of determining availability through concentrated engineering and mineral economic evaluations conducted on a current worldwide basis, was conceived by the Bureau of Mines in the late 1960's. Formal recognition of the Minerals Availability System as a viable program occurred in May 1975, when existing field efforts to gather and systematically store in-depth mineral deposit data (11),[4] and personnel involved in the economic evaluation of mineral properties (1-2, 6-7) were brought together. As data collection efforts continued in the Bureau's four Field Operations Centers, a small System Operations Group was formed in the Denver, Colo., field office to coordinate the data gathering function, institute economic evaluation procedures, and develop more efficient methods of handling the volume of information entering the system.

Initial data collection efforts emphasized domestic mineral properties, but the effort was soon expanded to give proportional emphasis to the gathering of foreign mineral deposit data. While the collection of domestic data continued to be accomplished by the Bureau's four Field Operations Centers, foreign information was initially acquired through university grants; these grants were subsequently replaced by contracts with private mining engineering firms obtained through competitive bidding, with the first contract of this type being awarded in September 1977.

The operational requirements of the MAS necessitated that the initial sequential computer system using punched card input (11) be replaced by an online data base management system with remote batch data entry and real-time retrieval capabilities; this new system was implemented in 1977.

The General Accounting Office (GAO) conducted an audit of the Minerals Availability System in 1977, and subsequently issued a report on July 17, 1978 (13). One GAO recommendation was that the Bureau of Mines should recognize the Minerals Availability System as a priority program. Accordingly, the Division of Minerals Availability was created on October 1, 1979.

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[4]Underlined numbers in parentheses refer to items in bibliography preceding the appendixes.

MISSION

The mission of the Minerals Availability System is to provide current appraisals of the engineering and economic availability of nonfuel minerals for consideration in the formulation of both domestic and foreign minerals policy. Since this is accomplished through the systematic engineering and economic evaluation of significant mineral deposits throughout the world, it has been necessary for the Bureau of Mines to develop both a repository of in-depth, site-specific information on worldwide mineral occurrences, and a reservoir of professional engineering and mineral economic expertise required to accomplish these minerals availability appraisals. In addition to the compilation of minerals availability studies, the Bureau's MAS personnel are frequently involved in special engineering and mineral economic projects for other Federal and State agencies.

PROGRAM PLAN

The 1981 MAS 5-year plan involves the determination of the worldwide availability of 23 strategic nonfuel minerals within a specified time frame. These mineral commodities, and the projected completion dates for their initial availability appraisals, are given in table 1.

TABLE 1. - Time frame for determining worldwide availability of selected strategic minerals

Commodity	Fiscal year		Commodity	Fiscal year	
	Domestic	Foreign		Domestic	Foreign
Copper	1979	1981	Potash	1984	1984
Aluminum	1981	1981	Fluorine	1984	1984
Chromium	1981	1982	Tungsten	1983	1983
Cobalt	1981	1982	Asbestos	1984	1984
Manganese	1981	1982	Titanium	1983	1983
Phosphate	1981	1982	Columbium and tantalum	1984	1984
Lead and zinc	1982	1983	Mercury	1984	1984
Nickel	1982	1982	Gold	1983	1983
Platinum	1982	1982	Silver	1983	1983
Iron	1983	1983	Molybdenum	1984	1984
Tin	1983	1984			

The selection and prioritization of these minerals was influenced by the Council on International Economic Policy (CIEP) 1974 Special Report entitled "Critical Imported Materials" (the Bureau of Mines participated in the development of this report). Although the CIEP report identified 33 critical mineral commodities, the Bureau included only 23 commodities in the 1981 5-year plan. The ultimate objective of the MAS program is to maintain current assessments on the engineering and economic availability of all nonfuel mineral commodities.

ORGANIZATION

The MAS program is an activity of the Assistant Director--Mineral Data Analysis of the Bureau of Mines. Direction and coordination are provided by the Division of Minerals Availability (DMA) in Washington, D.C., with all minerals availability studies and appraisals being accomplished by the Division's Denver, Colo., facility--the Minerals Availability Field Office. Primary domestic data

gathering and deposit evaluations are accomplished by the Bureau's four Field Operations Centers, while foreign mineral property information is collected through external contracts. An organization chart of the mineral Data Analysis function appears in figure 1.

Division of Minerals Availability

The Division of Minerals Availability has formal responsibility for the management and coordination of the overall Minerals Availability System. The Division Chief provides direction and control of all MAS activities, performs management functions including resource allocation, establishes operational relationships with outside organizations, and performs budget justification, acquisition, and distribution. Within DMA there are three principal staff elements (Supply Technology and Costs, Mine Evaluations, and Supply Analysis), and the Minerals Availability Field Office located in Denver, Colo.

The principal functions of the Supply Technology and Costs staff are management of the Division's financial resources, maintenance of operational and technical standards, and quality control of the computer network. The Mine Evaluations staff is responsible for the coordination of deposit evaluation progress, including foreign data collection through external contractors, and liaison with the Bureau's commodity and country specialists. The Supply Analysis Manager is responsible for managing mineral economic and sensitivity analysis activities as well as data base utilization within the MAS.

Minerals Availability Field Office

Under the direction of the DMA, the Minerals Availability Field Office (MAFO) is responsible for the engineering feasibility verification and economic evaluation of all site-specific data received from the Field Operations Centers and

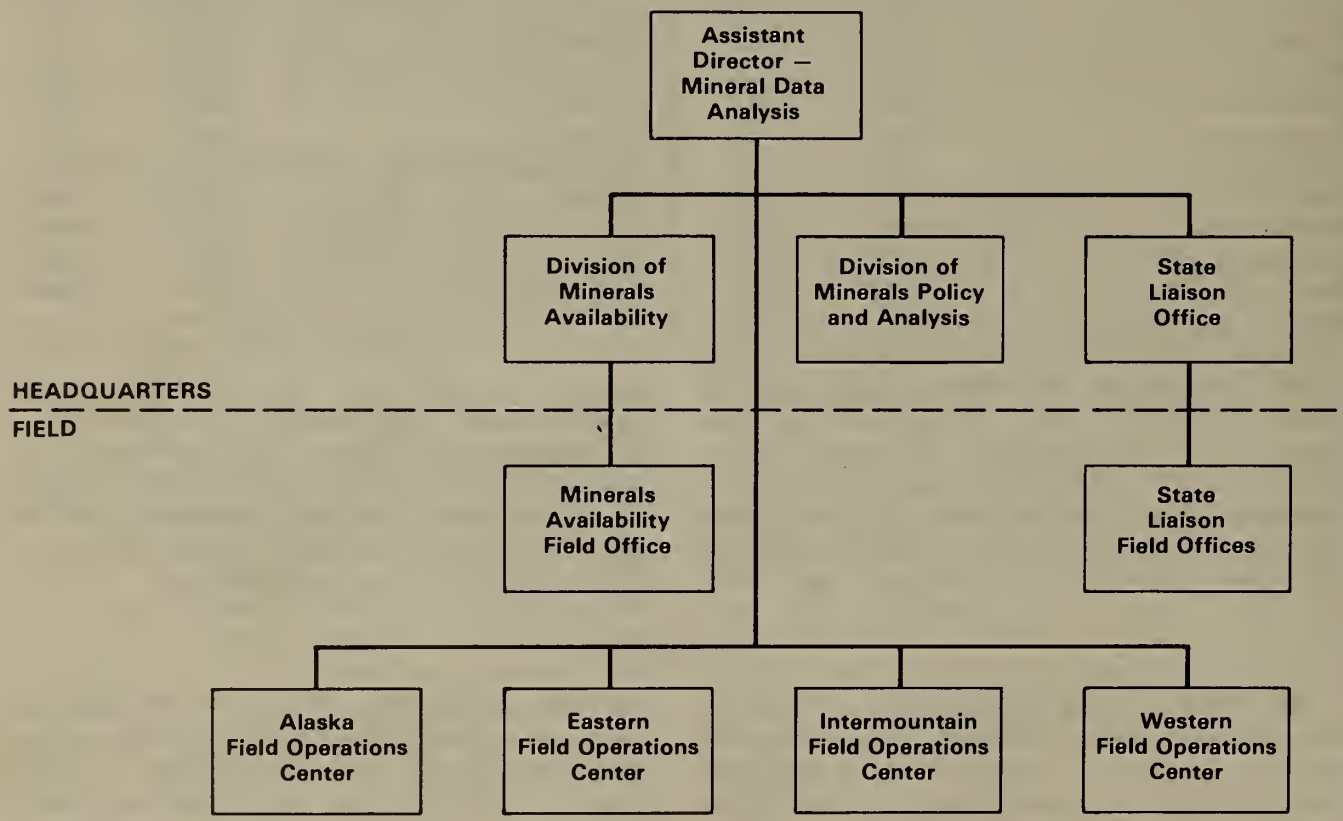

FIGURE 1. - Generalized organization chart.

private contractors, and the compilation of these data into commodity specific MAS appraisals. The review and quality control of the MAS data base and the design and implementation of the analytical methods and products needed for economic and supply-availability analysis, are performed with the computerized system support of the WANG VS[5] and the Burroughs 6800 system. In order to accomplish these studies, the MAFO personnel have strong backgrounds in the disciplines of mining engineering, metallurgy, geology, and mineral economics. Because of this expertise, the office has been involved in numerous special assistance projects relating to mining engineering and mineral economics for other Federal, State, and municipal agencies.

SYSTEM PROCEDURES

The sequential MAS procedures required to accomplish availability appraisals can be grouped into three categories: (1) deposit identification and selection, (2) data collection, and (3) data utilization. Activities within each of these major functions are in themselves sequential, thus forming the components of the MAS program workflow shown in figure 2.

Deposit Identification and Selection

Input from a consortium that included contributors from Federal and State Governments, industry, educational institutions, and other mineral-related organizations was used in the deposit identification and selection process. This widely varied input was valuable in the identification of all significant deposits for a given commodity, and was initiated and coordinated by the Program Manager, Mine Evaluations, and staff.

Typically, deposit identification began with literature search combined with meetings and/or correspondence with commodity and country specialists of the Bureau of Mines, commodity geologists of the U.S. Geological Survey, State Geologists, and other government and nongovernment geologists or mineral specialists. A preliminary list of deposits was developed, and further refined through several iterations of this activity, until a reasonable assurance was achieved by all participants that the list was inclusive.

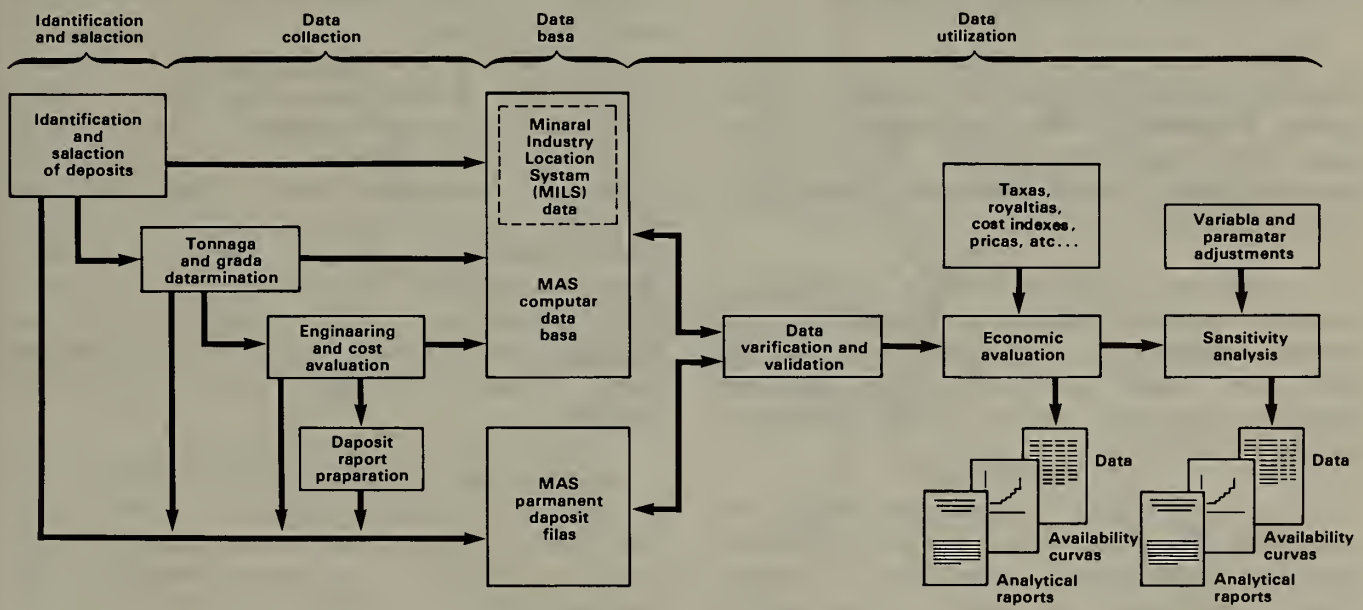

FIGURE 2. - MAS program workflow.

[5]Reference to specific equipment does not imply endorsement by the Bureau of Mines.

Concurrent with the development of the list of identified deposits, abbreviated deposit records were computerized for the purpose of documenting the selection and monitoring the progress of these deposits in subsequent MAS activities. This monitoring system, which contains data on property names, ownership, location, type of mining, production status, principal commodities present, and resource tonnages and grades, is called the Advanced Deposit Information and Tracking (ADIT) system; it resides on a Wang 2200 VS minicomputer system in the DMA offices in Washington, D.C. Other fields included for each deposit record in the ADIT system pertain to the funding and evaluation status of that deposit, and the tracking of the evaluation progress.

Having thus developed a list of deposits along with the required information, certain general criteria were then used to determine which of the identified deposits for a given commodity should be selected for further evaluation. These criteria include the following:

- Producing properties accounting for at least 85 percent of the commodity production; that is, 85 percent of the cumulative domestic production or 85 percent of the cumulative world production.

- Developing deposits where the demonstrated reserve-resource quantity (contained commodity) is equivalent to at least the lower limits of the reserve-resource quantity of the identified producing deposits.

- Explored deposits where the demonstrated reserve-resource quantity (contained commodity) is equivalent to at least the lower limits of the reserve-resource quantity of the identified producing deposits.

- Past producing properties where the remaining demonstrated reserve-resource quantity (contained commodity) is equivalent to at least the lower limits of the reserve-resource quantity of the identified producing deposits.

While a reasonable attempt was made to adhere to the assessment of at least 85 percent of the production or known resources of a particular mineral commodity, these guidelines are of necessity flexible in order to accommodate special circumstances of resource potential. The guidelines for the lower limits at which a mine or deposit would be evaluated are adjusted to the total content of contained commodity, the grade of the commodity, and possible byproducts.

Since the ADIT system is considered to be fundamental in the identification of significant mineral properties for evaluation, it is constantly being maintained and updated in preparation for potential revisions in MAS appraisals. As part of the subsequent data collection effort, it is occasionally discovered that a selected deposit no longer meets the general selection criteria, resulting in the removal of that deposit from further evaluation; or that a deposit not previously considered should be incorporated into the evaluation process.

Data Collection

Following the identification and selection of all mineral deposits to be included in each availability study, the next step was to acquire site specific geological and engineering data on each identified property. The type of data collected on an individual deposit basis includes those required to make grade and tonnage determinations, describe and develop a mining and beneficiation plan for a specified annual rate of production, estimate the associated capital and operating costs, and perform an economic evaluation using a discounted cash flow rate of return (DCFROR) method.

Sources of the information range from literature search to onsite visits, during which all available information (for example, maps, private reports, and resource data) is obtained from the owner or operator.

Domestic

Domestic deposit data collection and evaluations are performed by evaluators in the Bureau of Mines four Field Operations Centers (FOC's), following schedules established by the Program Manager, Mine Evaluations. The four Field Centers involved in the domestic data collection process are the Alaska Field Operations Center (AFOC) located in Juneau, Alaska, the Eastern Field Operations Center (EFOC) in Pittsburgh, Pa., the Intermountain Field Operations Center (IFOC) in Denver, Colo., and the Western Field Operations Center (WFOC) in Spokane, Wash. Figure 3 identifies the Centers and their respective geographical areas of responsibility.

Foreign

Foreign deposit data collection and evaluations are performed by contractors selected through the Government's competitive procurement procedure. The preparation of technical specifications and the monitoring of contract progress is performed by the Minerals Availability Field Office under the oversight of the Program Manager, Mine Evaluations.

Resource and Deposit Description

Resources are described in terms of the geology, mineralogy, grade, tonnage, economics, and reliability of the data (8), and are classified according to the system defined jointly by the Bureau

FIGURE 3. - Bureau of Mines field operations centers.

of Mines and the U.S. Geological Survey (12), illustrated in figure 4. If reliable resource estimates are not available in publications or through company contacts, deposit geometry is outlined in order to calculate volumes and tonnages.

The resource or deposit must be described to the extent that a mining and beneficiation plan can be established using current industry practices. Elements that must be addressed in the resource and deposit description include the following:

Identification

Property name

Type of operation

Current status

Ownership

Location by coordinate

Resource description

Type of deposit

Shape of deposit

Attitude and structural features affecting ore controls and mining.

Type of mineralization

Economic minerals

Deposit dimensions, thickness of mining horizons, veins, or zones.

Reserve-resource quantity, commodity assay, and year of estimate. The assay must include all commodities that are currently or potentially recoverable or that may affect the recovery or marketability of recoverable commodities.

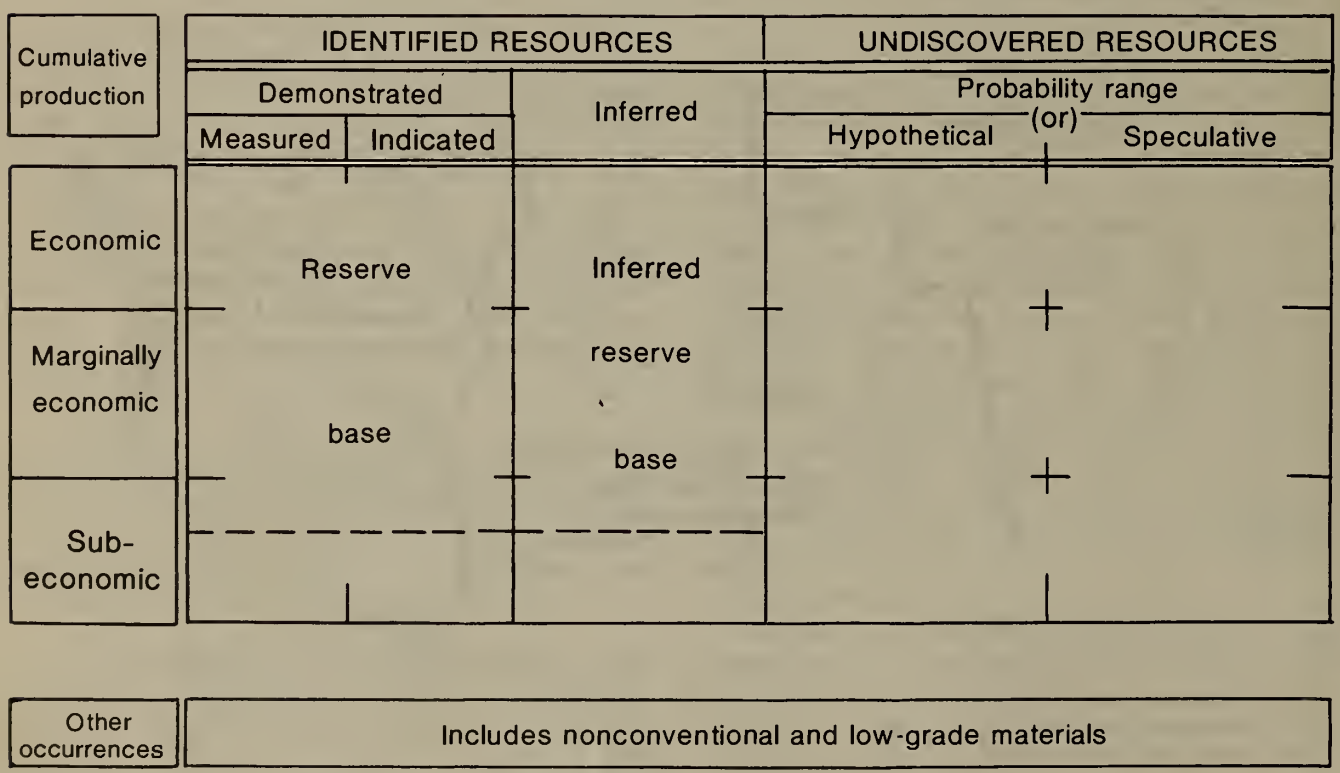

FIGURE 4. - Classification of mineral resources.

Engineering and Cost Evaluation

Realistic development plans using the resource and deposit description data are prepared in sufficient detail to allow the estimation of the capital and operating costs required to produce and market the contained minerals. The type of data collected or developed by the individual preparing the engineering cost study is as follows:

Surface Mining

Design capacity (metric tons per 24 hours--ore and waste).

Operation schedule (shifts per day, days per year).

Average annual production rate (metric tons of ore and waste and year(s) for average).

Excavation and loading methods and major equipment utilized, ore and waste.

Haulage methods, average haul distances, and major equipment utilized for ore and waste.

Destination or placement of ore and waste; that is, stockpile, dump, tailings dam, etc.

Breakage requirements and major equipment utilized; powder factor.

Dilution factor, waste: ore ratio, average thickness of mining horizon.

Water drainage requirements--description of methods, rate, head.

Year of initial production, ore production and grade for prior 15 years or years since startup, whichever is less.

Underground Mining

Design capacity (metric tons per 24 hours--ore and waste).

Operation schedule (shifts per day, days per year).

Average annual production rate (metric tons of ore and waste and year(s) used for average), destination of ore and waste.

Year of initial production, ore production for prior 15 years or years since startup, whichever is less.

Specific mining methods and percent of production from each method, thickness of mineralized zone.

Orebody access and haulage--orebody access methods and ore haulage facilities as indicated by the following:

1. Underground haulage methods, major equipment (size and number) utilized, and average haul distance and elevation difference.

2. Hoist(s) identification--designation, location (placement), type, use, general area served, height or depth.

3. Inclines and adits--length or depth.

Rock hardness-abrasiveness, powder factor, support-lining requirements.

Water drainage requirements--description of methods, rate, head.

Mine diagram and plant layout, if available.

Beneficiation

Beneficiation methods

Feed grade, each method. Explain any dilution and/or blending that make this grade different from the in situ commodity grades.

Design capacity, each method (metric tons of feed per 24 hours).

Average production rate (metric tons of feed per year and year(s) used for average).

Operation schedule (shifts per day, days per year).

Commodity recoveries

Beneficiation product identification

Product type

Product grade

Product quantity (metric tons per year).

Description of size reduction methods, final grinding size.

Tailings disposal--description of methods, including distance and methods of transport, pumping head, and impoundment methods.

Major equipment utilization, size and number.

Flowsheet

Manpower requirements (mine and mill)

Labor

Technical

Supervisory

Pay schedules

Productivity (metric tons per man-shift or analysis of manpower efficiency).

Infrastructure[6]--Quantification of the following elements:

Access and haulage facilities

Roads and railroads

Pipelines

Conveyors

Tunnels

Other

Water supply facilities

Power supply

Personnel accomodations

Other

Postmine Processing

Location

Type of process used

Capacity (input and output)

Sources of feed from producing and potential developments.

Grade of input and output

Estimates of costs, penalties, etc., charged to customers.

Ownership

[6]The purpose of the infrastructure data is to identify those areas of infrastructure that a deposit would need in order to develop the reserve-resource. If this infrastructure exists, or can be built at no cost to the deposit, this should be identified.

These engineering and cost evaluation data items reflect the current or proposed future practices at existing operations. For the explored and developing properties, they reflect the development plans proposed by the corporate entity controlling the deposit. If a plan is not available, the evaluator is required to develop a plan.

To insure that the evaluations are performed on a common basis, guidelines are developed by DMA for each commodity. In these guidelines the specifications of the marketable product are established.

Categories for which capital costs are developed include acquisition of the property, exploration, development, infrastructure, and mine and mill plant and equipment. Capital expenditures for the mining and processing facilities include the costs of mobile and stationary equipment, construction, engineering, facilities and utilities, and working capital. Facilities and utilities (that is, infrastructure) cover a broad category that includes the costs of access and haulage facilities, the water system, fire protection, roads, fences, fuel and power facilities, etc. Working capital is a revolving cash fund required for operating expenses such as labor, supplies, taxes, and insurance.

Total operating cost is a combination of direct and indirect costs. Direct operating costs include materials, utilities, direct and maintenance labor, and payroll overhead. Indirect operating costs include technical and clerical labor, administrative costs, facilities maintenance and supplies, and research. Other costs developed during the deposit evaluation are fixed charges including taxes, insurance, depreciation, deferred expenses, and interest payments (if applicable).

Actual costs associated with a deposit are used when available; these are usually obtained from published or company data. Engineering estimates must be made where actual costs are either nonexistent or unavailable. In this instance, the final results are compared to actual data obtained from company Annual Report Form 10-K's, published articles, or company representatives. For those deposits for which data are not available, a comparison is made with the available costs for deposits having similar characteristics, such as the mining and beneficiation methods, and rate of production.

To assist in the estimation of costs, the Bureau handbook titled "Capital and Operating Cost Estimating System Manual for Mining and Beneficiation of Metallic and Nonmetallic Minerals Except Fossil Fuels in the United States and Canada" was developed under contract (4). This cost estimating system (CES), based on an average of the costs for existing operations in the United States and Canada, covers operations of varying sizes. Conditions that were unique to an operation and influenced the cost were factored from the actual cost to obtain the average cost; factors are provided to adjust the average cost to reflect more severe situations. Since the objective was to develop a method for the preparation of feasibility type estimates for capital and operating costs of mining and beneficiation of various types of mineral occurrences using state-of-the-art technology, the handbook was developed for a user with knowledge and experience in both mining and estimating procedures. The expected variance of the estimated total capital and operating cost, and the expected actual cost for an operation, is plus or minus 25 percent; however, there may be a wider variance for any single component (that is, loading, crushing, etc.) between the handbook-derived cost and the expected actual cost.

In order to compare worldwide costs on a common basis it is necessary to convert the foreign deposit data to U.S. currency. Also, the cost data require updating on an annual basis. To accomplish this as well as the determination of costs such as taxes and depreciation, specific economic indexes, country specific tax regulations, and monetary exchange rates are collected and applied.

Since CES was developed for use in estimating U.S. costs, factors have also been developed so that the derived costs take into account the differences of productivity, labor rates, tariffs, and items affecting the cost of doing business in a specific nation. These data have been or are in the process of being collected for 95 foreign countries.

Additional cost data, if required to market the commodity, are developed for postconcentration processing and transportation to market.

An economic time diagram (ETD), which is a complete time sequence of the capacities and grades versus investments and operating costs required to produce the marketable product(s) over the life of the property, is subsequently constructed. This is the end product of the engineering and cost evaluation process, and it is included in the deposit report.

Deposit Report

Reporting requirements for the MAS program include the preparation of a deposit report detailing the engineering and cost evaluation results. All supportive data items including identification, resource and deposit description, development plan, mining and processing methods, and capital and operating costs are addressed. In addition, backup files contain all pertinent material collected during the investigation. These backup files, for domestic reports, are maintained at the appropriate Bureau of Mines Field Operations Center. For foreign deposits the backup data files are maintained at the Minerals Availability Field Office. Backup files generally contain data relating to the following categories:

- Deposit file reports for deposits selected for inclusion in mineral supply availability study.

- Smelter, refinery, and other postmine or postmill processing data.

- Worldwide mining and metallurgical technological data.

- Worldwide geologic and topographic maps and various mine maps and plant flowcharts.

- Mining company proprietary reports.

- Trip reports from property visits and other information obtained through personal contact with industry officials.

- Supporting data and calculations used to derive resource quantities and materials flow.

- State and foreign country tax and economic data.

- References and source material used in the deposit evaluation.

Data Base

As previously described, for each deposit evaluated within the MAS program a large amount of site-specific data are both gathered and computed. Descriptive information, along with all geologic and engineering data pertinent to that deposit, form the basis for both a deposit report and for a computer data base deposit record. While the text of the deposit report contains details, maps, tables, and the rationale for engineering and cost estimates, it is the data that are eventually entered into the MAS data base which are used, directly or indirectly, to perform the analytical functions that allow determination of the availability of resources from that deposit.

Deposit records of MAS data reside on the Bureau's Burroughs 6800 computer located in Denver, Colo. Although the structure of the MAS data base has evolved significantly from its initial development in the early 1970's, Information Circular 8654, "The Bureau of Mines Minerals Availability System and Resource Classification Manual," published in 1974, described in detail the various

data elements that still comprise the bulk of deposit data on the present MAS data base.

Each property record on the MAS consists of over 418 specific items of data or "data elements." In some cases individual data elements themselves are composed of a series of values, such as "capital investments" over time. Organizationally, the 418 data elements are grouped into 32 categories or "data sets" (fig. 5). These 32 data sets are grouped into the following five major categories of information:

- Deposit identification
- Deposit definition
- Development plan
- Product definition
- Environmental assessment

Within each of these five major categories the data sets are of two types: those which contain information essential for overall availability assessment of the deposit, or "base data sets," and those that contain additional information used by the deposit evaluator in making the investigation, or "backup data sets."

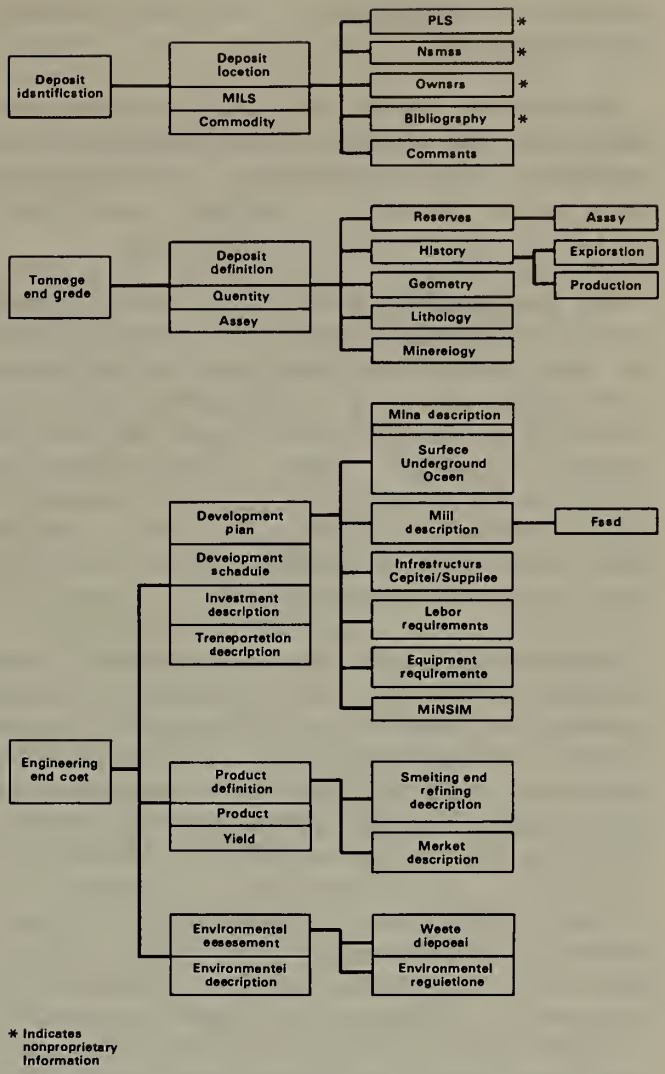

FIGURE 5. - The MAS data base—a deposit description.

The deposit identification base data set encompasses location, topography, name of the deposit, and the commodities present. The backup data sets for this category include information on public land surveys, additional names, ownership, references, and comments. This category or data set is most important to the MAS data base, for it is through this data set that all other data sets on the MAS are accessed. This data set forms the basis for all properties on the MAS, including postmill processing plants and other mineral related industry sites, and is referred to as the MILS (Minerals Industry Location System) data set. To date there are over 180,000 records in the MAS data base for which required information in this MILS data set have been entered. (A further discussion of the MILS is given in the "Products" section of this report.)

The deposit definition data set contains information on quantities of resources and the assays of commodities in the resource. Backup data sets include published reserve information, exploration and production histories, deposit geometry, lithology, and mineralogy.

The deposit development plan base data set relates a time frame to the mining and milling plan(s), and also includes investment and transportation schedules. Backup data sets contain mine and mill descriptions, infrastructure, labor and

equipment requirements, and economic evaluation data.

The product definition data set defines the type and amount of recoverable commodities from the deposit. Its backup data sets identify further smelting, refining, and market requirements.

The environmental assessment data set describes the effect that the development of the properties has, or would have (depending on its present production status), on general environmental conditions. Backup data sets identify expected waste disposal and environmental regulations. Appendix B contains the name of the data elements within each of the respective data sets.

Domestic deposit data entry is the responsibility of the Bureau's Field Operations Centers, where original evaluations are performed and entered into the MAS data base. Foreign data are received from contractors by MAFO and are entered into the MAS data base by that office.

Much of the data in each record is permanent, such that it will not change, while other information is temporal or subject to change given new information or perspective on the specific deposit. Examples of fixed information are latitude, longitude, lithology, mineralogy, etc. Temporal information includes development schedules and costs. Resource data as well as mine and mill plans are also subject to change when new information is obtained. Maintenance of the MAS data base is therefore required for both the temporal and dynamic information, and is the responsibility of both the Field Centers and MAFO. In addition, all costs are dated on the data base, so that through cost update programs values can be converted to constant time unit values for analysis.

As previously mentioned, the MAS data base resides on the Bureau's Burroughs 6800 computer. Management of the data base is accomplished through the Burrough's data base management system, DMS II. Input to the data base is made through WANG 2200 VS peripheral computers located in the Field Centers and MAFO, which interface with the Burroughs through telecommunications. Data output from the Burroughs is achieved through standard input-output devices, including Tektronix terminals and Cal-Comp plotters for graphics output.

Because of the proprietary nature of much of the data in the MAS data base, access to the information on the data base is restricted. Proprietary data elements are "flagged" within the system so that security can be maintained and listings of nonproprietary information can be made available to the general public.

Data Utilization

Verification

Copies of all deposit reports and supportive data are forwarded to MAFO for use in developing analyses of the availability of the contained minerals on a domestic and worldwide basis. Data received from the Field Operations Centers and the contractors are reviewed by MAFO for feasibility and consistency. In this verification process, which provides the first opportunity for all deposits relating to a specific mineral commodity to be examined collectively, significant data items such as costs and recovery factors are arrayed and compared in order to identify anomolies; further review of the anomolous data indicates whether the variation is warranted, or inconsistencies exist in the development of the plan and/or costs. MAFO personnel use the supportive backup information, resident technical expertise (that is, mining engineers, metallurgists, mineral economists, and geologists), and CES in the verification procedure.

Economic Evaluation

Data derived during the engineering and cost evaluation, and the verification process, reside in the ETD's; these are used in an economic feasibility analysis of each deposit, which indicates the

economic availability of the deposit in terms of the cost (inferred commodity price) per unit of recoverable mineral commodity at a specified return on unamortized capital investment.

In the late 1960's the Bureau of Mines developed the MINSIM (MINeSIMulator) computer program, which simulates a mining operation during its productive life using specific operating characteristics, costs, and revenues (2, 7). This program is a comprehensive economic evaluation simulator that enables the user to perform DCFROR analyses. As an option, this computer program can also be used to determine the mineral commodity selling price required to obtain a specified rate of return, or net present value of an operation at a specified rate of return. A listing of the MINSIM input parameters is contained in appendix C.

Using the results of MINSIM, discrete economic evaluation-mineral resource availability curves were manually assembled. However, because of the growing need to rapidly analyze the impact of several factors upon the availability of a commodity and to modify information within a defined population of deposits (for example, domestic phosphate, worldwide copper), a Supply Analysis Model (SAM) was developed (5). This model combines the MINSIM program with peripheral subroutines and data files, permitting the modification of deposit data parameters either within the total defined population, or upon selected deposits, as required. Scenarios can be made to observe the impact of legislation at the local, State, or Federal level which may impact costs either directly or through taxation. Analyses can also be made by varying input parameters to determine the impact of changing grade, recovery factors, energy costs, labor rates, return on invested capital, severance taxes, depletion allowances, investment credits, tax holidays, and other deposit and economic considerations.

The output from SAM is presented in both tabular and graphic form. Graphic output consists of individual deposit tonnage and cost data aggregated as resource availability curves. Two general types of resource availability curves, based upon degree of certainty and geographic coverage, are currently used.

One type of curve (fig. 6, curves A and B) does not consider time, but is a representation of the toal available recoverable quantity of resource at a unit cost (price) and at a specified rate of return on unamortized invested capital. Curves of this type, developed through the economic evaluation of worlwide deposits, define the worldwide reserves for particular commodities as a function of cost. The unit cost on the curve, compared with current market unit cost, permits the classification of each deposit's material as economic, subeconomic, or marginally economic at a specific point in time. The deposit information also is categorized as to the degree of certainty of the geologic knowledge concerning the resource, (that is, measured, demonstrated, or identified). The system further permits updating for inflation, production, and price changes, in order to provide an availability assessment for a future time period (for example, 1979 data can be updated to reflect the situation in 1981).

The total availability curve is a discontinuous function relating the level of average total cost for individual deposits to the cumulative level of production from the deposits throughout their lives. This type of curve is different from a traditional economic supply curve. It is the sum of total potential production from each deposit at incremental commodity costs, which covers the full (rather than the marginal) cost of production for each deposit. It is assumed that the given price and associated level of output (or capacity) remain constant over the entire producing life of the property. The curve shows the availability of a commodity at specified long-run costs.

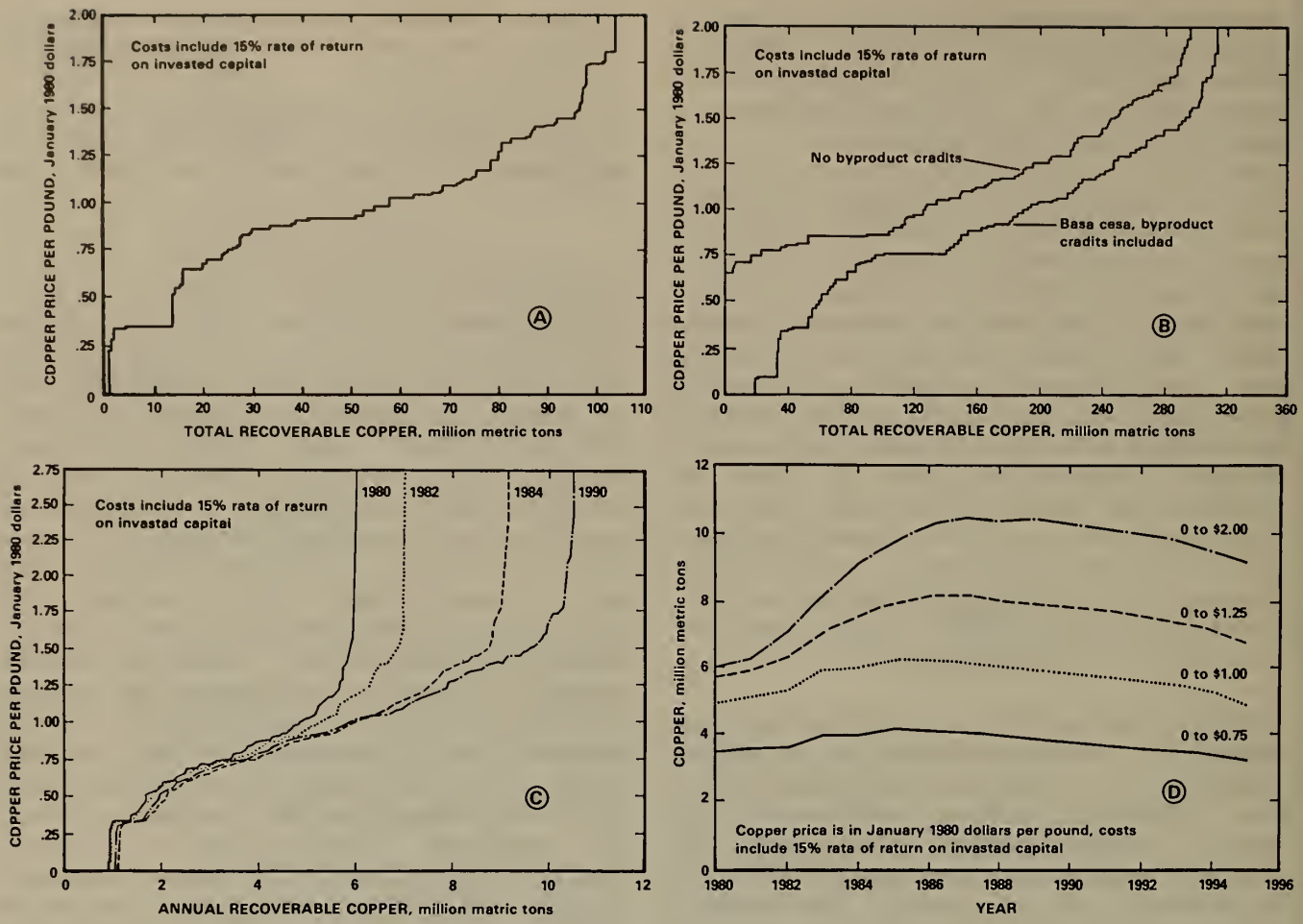

FIGURE 6. - Sample availability curves.

Other types of curves (fig. 6, curves C and D) are disaggregations of the total curve data on an annual production basis.

All curves are based on the following assumptions:

- Preproduction development for each nonproducing deposit begins in January of the year of the study.

- Production starts immediately after completion of development regardless of demand.

- Each operation will produce at full capacity throughout its life.

- Competition and demand conditions are such that each operation will be able to produce all of its output at the derived cost (price).

All coproduct and byproduct credits are also considered in the economic evaluation process.

Sensitivity Analysis

Using the SAM, sensitivity analysis can be performed on selected input variables to measure their significance to the costs and availability of resources from a deposit or group of deposits. Input values that have been measured include taxes (State and Federal), depletion allowance, byproduct credits, energy costs, transportation, payment schedules, capital costs, operating costs, proposed grants or loans, and labor costs. Examples of sensitivity analysis using the MAS can be seen in figure 7. Four input factors to the SAM were tested (under separate runs) to determine if they had any significant economic impact on the

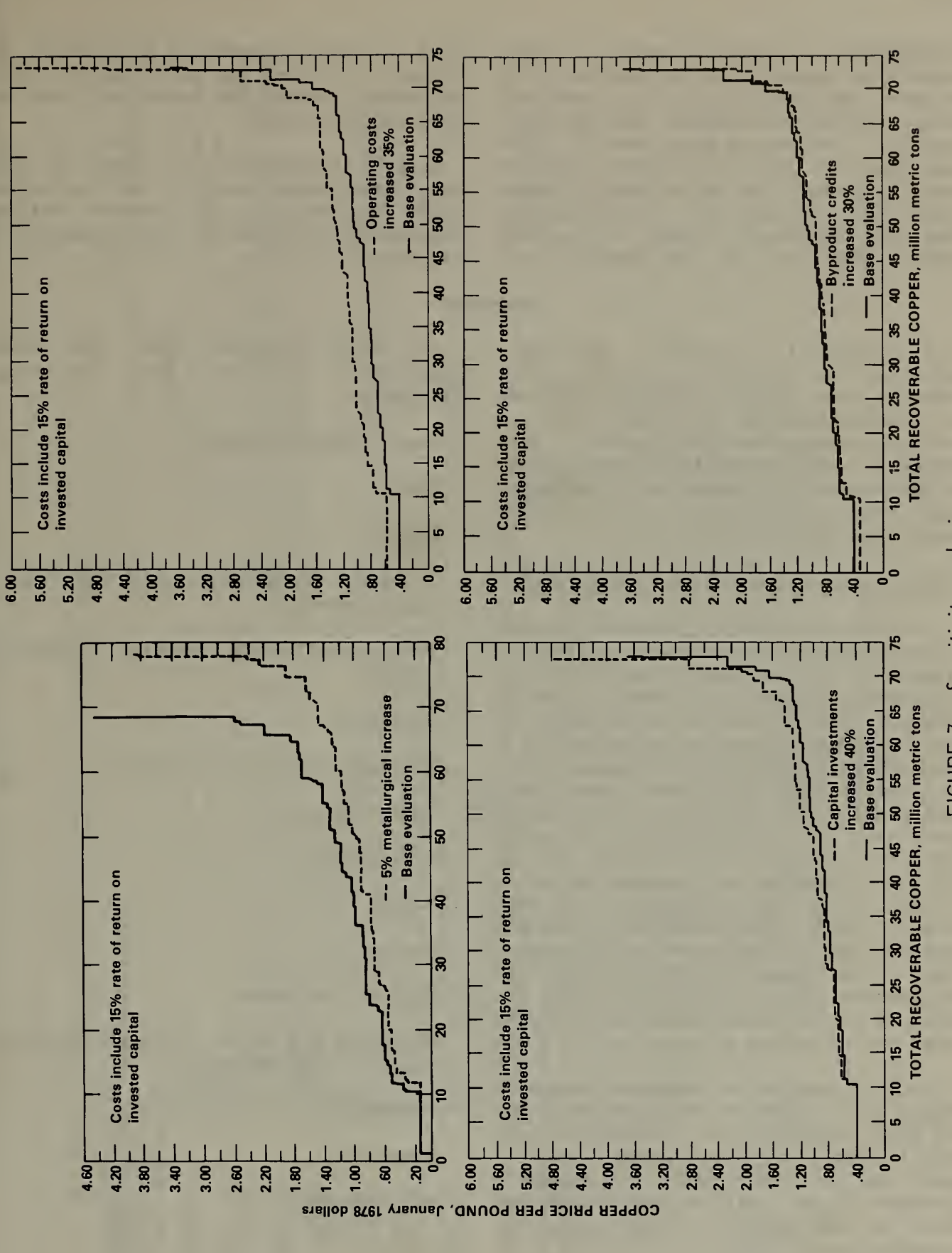

FIGURE 7. - Sensitivity analysis curves.

availability of domestic copper. These factors are lower ore grade (reflected in increased metallurgical costs), operating costs, capital investments, and byproduct credits. It can be seen that in 1978 both lower ore grade and higher operating costs in general had significantly higher impacts on the cost of domestic copper than did byproduct credit or capital costs. This is not the case in 1980 (fig. 6, curve A) when the surge in price for gold, silver, and other metals significantly lowered the operating cost of many copper mines.

As new commodities are added to the MAS, sensitivity analysis is performed where measurement of current policy issues can be adequately and successfully addressed.

PRODUCTS

In addition to published, open file, and other distributed reports, many other products from the MAS program are used in the availability procedure and are available for public distribution. This includes both nonsensitive data as well as MAS information aggregated in a manner that does not compromise individual deposit proprietary information.

Mineral Industry Location System (MILS)

The Mineral Industry Location System (MILS), a mineral location oriented subsystem of MAS, involves identifying and cataloging all past and present domestic mineral operations and occurrences. A mineral industry location is defined as a metallic or nonmetallic occurrence, prospect, mine (including past producers), geothermal well, or mineral processing plant such as a mill, smelter, or refinery; the system is not limited only to the identification of mineral deposits. MILS is essentially a domestic data base except for approximately 2,000 MAS entries that include major foreign deposits. The domestic data entries and maintenance are administered by the Bureau's four Field Operations Centers, under the direction of DMA.

The MILS program is computer-oriented. Figure 8 is a sample MILS entry form. All MILS information is remotely entered onto the MAS computer data base, and the data are available only in computer-generated form. MILS output is distributed to the public at the cost of reproduction.

The data entered into the MILS subsystem includes the following categories:

- Name, reference number
- State
- County
- Latitude, longitude, universal transverse mercator
- Public land survey (section, township, range)
- Elevation
- Reference point and precision
- Owner-operator
- River basin
- Domain
- Status
- Type of operation
- Map name and scale (largest available scale, 1:250,000 map)
- Commodities
- Comments
- Bibliography

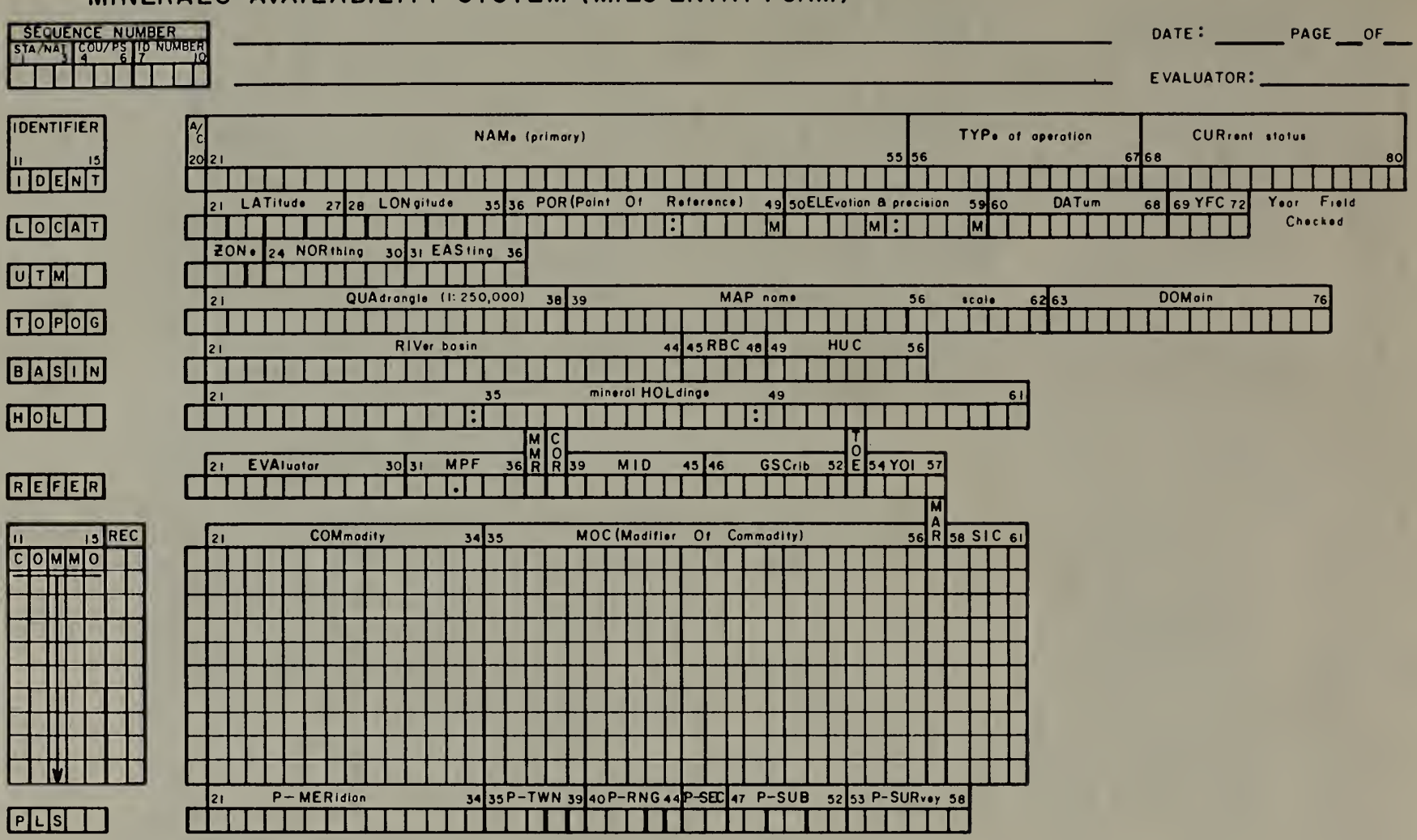

FIGURE 8. - MILS entry form.

MILS data are available both as hard copy listings and computer graphics. These listings and graphics can be produced for specified mineral commodities and geographic areas.

The graphic products of MILS are in the form of clear Mylar overlays showing locations in a variety of assemblages and map scales. Because of the limitation of showing a relatively large number of locations in small areas, most MILS locations are shown as clusters, with the clustering criteria being dependent on map scale, as follows:

Scale	Radius, miles
1:24,000	0.10
1:62,500	.25
1:250,000	1.0
1:500,000	2.0
1:1,750,000	7.0
1:2,500,000	10.0
1:3,166,000	12.0

The Mylar overlays can be generated for maps of various projections and scales; however, the most frequently requested are for U.S. Geological Survey topographic maps of 1:250,000 and 1:500,000 scale, State maps, and geologic maps. An indexed listing of the MILS data is provided with each overlay. The originals of overlays prepared for specific commodities are maintained as an open-file library service at the Bureau of Mines Field Operations Centers. Custom output is available upon request, but is usually more costly due to the additional programing and computer time involved. An example of a clustered location transparent overlay and base map is shown in figures 9 and 10, and example of the deposit listing from one of the clusters is shown in figure 11, and a partial listing of the compelete MILS data from the same cluster location is duplicated in figure 12.

Magnetic tapes containing MILS data are also available upon request, at a cost covering the tapes and computer time required to produce them. Four reels of magnetic tape are currently required to contain the domestic MILS information.

MILS printouts have been used extensively by mining companies and by municipal, county, State and Federal land use planners. MILS presently contains in excess of 180,000 domestic entries. The system is described in detail in a recent publication, "MILS: The Mineral Industry Location System of the Federal Bureau of Mines" (3).

MAS Data Base

The information in the previously described MAS data base contains certain nonproprietary data sets that may be distributed to the public. These are computer reports that are termed MILS, MILSR, AND MASNC. Other nonpublic data are also on the data base. The MAS report is the most comprehensive followed by a limited MAS report--Q9. An example of the computer printout is shown in appendix D. The reports and the data fields contained in each report are as follows:

MILS.--(1) MILS data set, (2) commodity data set, (3) alternate names, (4) ownership, and (5) bibliography.

MILSR.--(1) All fields in MILS and (2) published reserves and their assays.

MASNC.--(1) All the fields in MILSR, (2) geometry of the mineralized zone, (3) lithology, (4) rock types, and (5) mineralogy of the deposit.

Q9.--(1) All the fields in MASNC, (2) resource quantity, (3) development, (4) investment, (5) concentrator, (6) production, (7) suface and/or underground mining description, and (8) transportation.

Mine Map Repository

The mine map repository provides a microfilm inventory of past and present domestic mine maps, and has proven itself to be invaluable in providing information

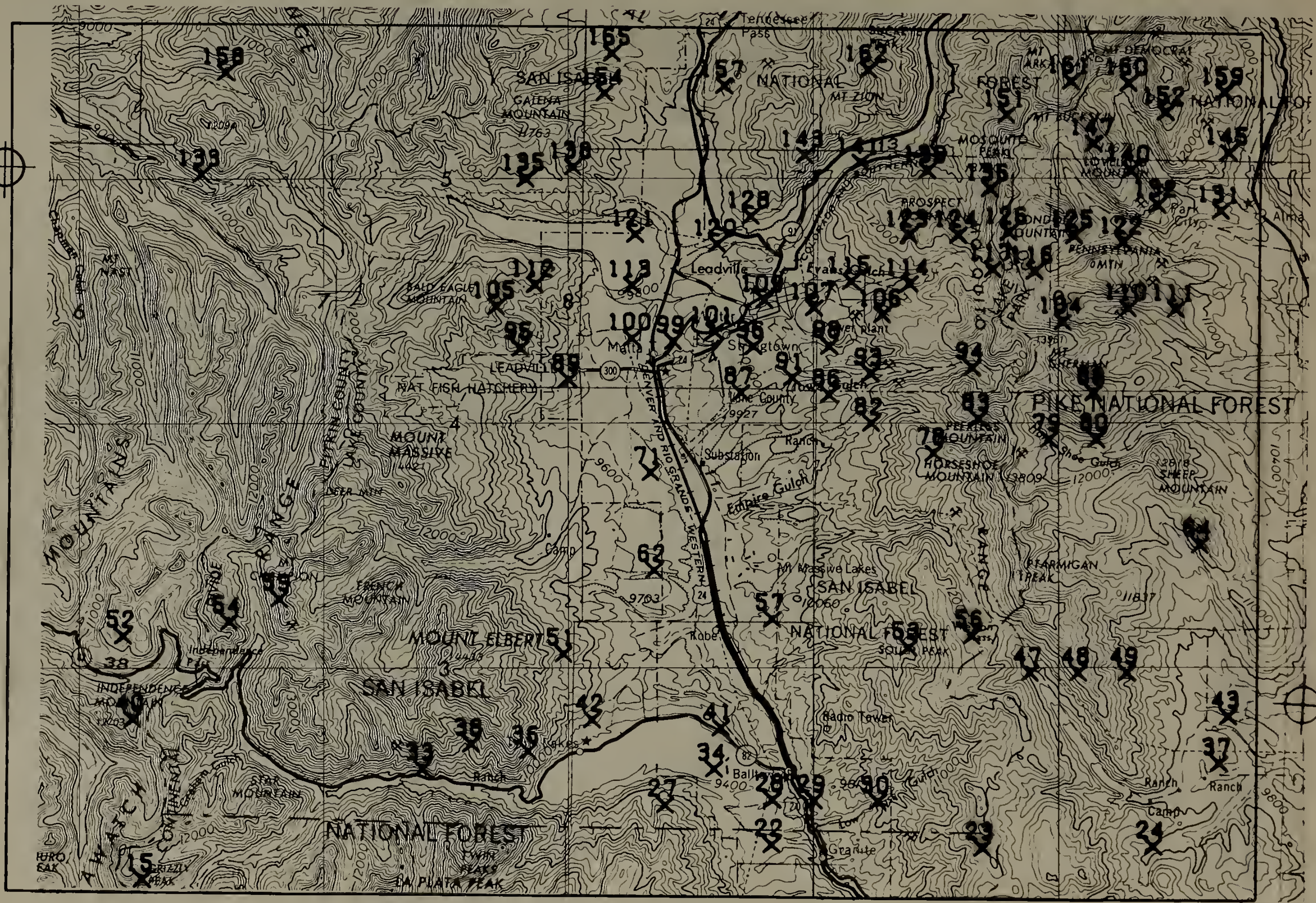

FIGURE 10. - Leadville, Colo., 1:250,000 scale quadrangle.
FIGURE 9. - Clustered MILS locations—sample Mylar overlays.

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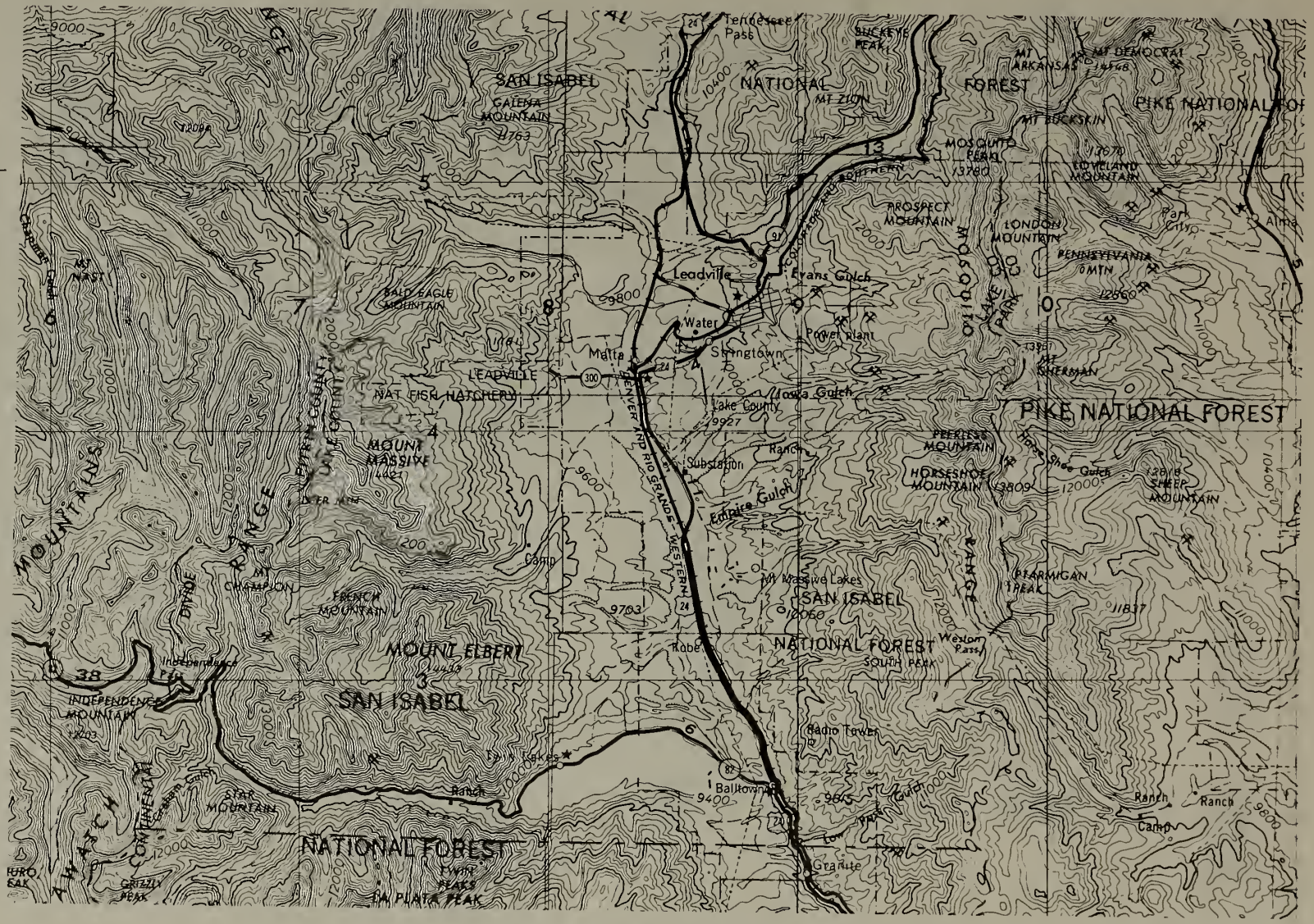

FIGURE 10. - Leadville, Colo., 1:250,000 scale quadrangle.

MAP TITLE: LEADVILLE QUADRANGLE

	CLUSTER NUMBER	NO. OF ENTRIES	SEQUENCE NUMBER	PRIMARY NAME
CONT	83	5	0080930088	DAUNTLESS MINE
			0080930160	LAST CHANCE
			0080930183	MILLER SHAFT
			0080930221	ROB ROY SHAFT
	84	1	0080970093	HOMESTEAD
	85	1	0080970012	COAL BASIN MINE
	86	3	0080650113	BECK SHAFT
			0080650273	LONG & DEERY
			0080650278	LYONS PLACER
	87	1	0080650234	IOWA GULCH
	88	10	0080930091	DENVER MINE
			0080930096	EMMA
			0080930158	KURT MINE
			0080930163	LITTLE NELL MINE
			0080930164	LITTLE NELLIE
			0080930228	SACREMENTO
			0080930233	SHERWOOD
			0080930235	SILVER STAR
			0080930236	SITTING BULL
			0080930274	WATSEKA
	89	1	0080650413	YOUNGER
	90	1	0080970137	MUNN TUNNEL
	91	48	0080650008	BULLSEYE MINE
			0080650012	GREAT O'SULLIVAN MINE
			0080650014	NISI PRIUS MINE
			0080650015	TUCSON MINE
			0080650016	WHITE CAP MINE
			0080650024	EMMETT MINE
			0080650064	GAMBETTA MINE
			0080650099	ALTOONA
			0080650117	BEN BURB SHAFT
			0080650119	BESSIE WILGUS SHAFT
			0080650152	COLUMBIA #2 MINE
			0080650153	COLUMBIA TUNNEL
			0080650157	COON VALLEY
			0080650158	CRESCENTIA SHAFT
			0080650159	CROWN POINT
			0080650165	DODRIDGE
			0080650166	DOME
			0080650168	DOUBLE DECKER
			0080650177	ESTAY TUNNEL
			0080650182	FANNY RAWLINS
			0080650192	GIANT
			0080650194	GLEASON
			0080650215	HABENDUM
			0080650241	JOHNSON
			0080650246	KENO SHAFT
			0080650285	MINNIE PUMP SHAFT

FIGURE 11. - Partial listing of MILS locations.

```
MAP TITLE= LEADVILLE QUADRANGLE

  91 NAME= COLUMBIA #2 MINE                          SEQUENCE NUMBER= 0080650152
     STATE= COLORADO                 COUNTY= LAKE                  ELEV:PREC= 3231M:500M
     LATITUDE=   N 39 13 54        PRECISION=   10M
     LONGITUDE= W 106 16 08  REFERENCE POINT= MAIN ENT
     UTM:  ZONE 13N  NORTHING 4343043  EASTING 390480
     PUBLIC LAND SURVEY  TOWNSHIP= 009 S   RANGE= 079 W
        DESCRIPTION      SECTION= 31  SECTION SUBDIVISION= SW
     RIVER BASIN= 48C   ARKANSAS RIVER            DOMAIN= PRIVATE
     STATUS= PAST PRODUCER  OPERATION TYPE= UNDERGROUND
     MESA ID NO.           YEAR FIELD CHECKED=     MAP REPOSITORY=  FOC
     MAP NAME= LEADVILLE SOUTH    TYPE= 7.5 MIN
     1:250,000 MAP NAME= LEADVILLE          MINERAL PROPERTY FILE=
     PRIMARY NAME= COLUMBIA #2 MINE
     COMMOD/MOD=  GOLD                                    LEAD
                  ZINC
     USGS LEADVILLE SOUTH QUAD


  91 NAME= COLUMBIA TUNNEL                           SEQUENCE NUMBER= 0080650153
     STATE= COLORADO                 COUNTY= LAKE                  ELEV:PREC= 3231M:500M
     LATITUDE=   N 39 13 58        PRECISION=   10M
     LONGITUDE= W 106 16 03  REFERENCE POINT= MAIN ENT
     UTM:  ZONE 13N  NORTHING 4343164  EASTING 390600
     PUBLIC LAND SURVEY  TOWNSHIP= 009 S   RANGE= 079 W
        DESCRIPTION      SECTION= 30  SECTION SUBDIVISION=
     RIVER BASIN= 48C   ARKANSAS RIVER            DOMAIN= PRIVATE
     STATUS= PAST PRODUCER  OPERATION TYPE= UNDERGROUND
     MESA ID NO.           YEAR FIELD CHECKED=     MAP REPOSITORY=  FOC
     MAP NAME= LEADVILLE SOUTH    TYPE= 7.5 MIN
     1:250,000 MAP NAME= LEADVILLE          MINERAL PROPERTY FILE=
     PRIMARY NAME= COLUMBIA TUNNEL
     COMMOD/MOD=  LEAD                                    ZINC
                  SILVER
     MINE MAP REPO #410158 #410161


  91 NAME= COON VALLEY                               SEQUENCE NUMBER= 0080650157
     STATE= COLORADO                 COUNTY= LAKE                  ELEV:PREC= 3231M:500M
     LATITUDE=   N 39 13 37        PRECISION=   10M
     LONGITUDE= W 106 16 06  REFERENCE POINT= TRENCH
     UTM:  ZONE 13N  NORTHING 4342518  EASTING 390520
     PUBLIC LAND SURVEY  TOWNSHIP= 009 S   RANGE= 079 W
        DESCRIPTION      SECTION= 31  SECTION SUBDIVISION= NW
     RIVER BASIN= 48C   ARKANSAS RIVER            DOMAIN= PRIVATE
     STATUS= PAST PRODUCER  OPERATION TYPE= SURFACE
     MESA ID NO.           YEAR FIELD CHECKED=     MAP REPOSITORY=  FOC
     MAP NAME= LEADVILLE SOUTH    TYPE= 7.5 MIN
     1:250,000 MAP NAME= LEADVILLE          MINERAL PROPERTY FILE=
     PRIMARY NAME= COON VALLEY
     COMMOD/MOD=  MANGANESE
     USGS LEADVILLE SOUTH QUAD
```

FIGURE 12. - Partial listing of complete MILS data.

required in land use planning, mine disasters, real estate development, etc. This information is available through the Bureau's Eastern Field Operations Center in Pittsburgh, Pa.

Cost Estimating System

The cost estimating system is available both as a hard copy report (4) and as a computer listing from the Wang 2200 VS minicomputer system. The program is written in the BASIC language. An example of computer output from this system is shown in figure 13.

MINSIM

The latest version of the MINSIM economic evaluation computer program (that is, MINSIM-OPEN), written in FORTRAN IV and COBOL, and compatible with most major computer systems, is available upon request on either punch cards or magnetic tape. A nominal charge is involved to cover the costs incurred for copying.

MAS Publications

As of January 1, 1982, the Minerals Availability System appraisals published by the Bureau of Mines include

Information Circular 8809, "Copper Availability--Domestic," 1979

Information Circular 8848, "Cobalt Availability--Domestic," 1981

Information Circular 8861, "Aluminum Availability--Domestic," 1981

The following availability appraisals are in preparation:

Chromium--Domestic	Copper--Worldwide
Manganese--Domestic	Alumina--Worldwide
Phosphate--Domestic	Platinum--Worldwide

TECHNICAL SERVICES

Because of their specialized mineral economic expertise, Bureau personnel are frequently involved in special engineering and mineral economic projects for other Federal and State agencies. MAS personnel have provided direct technical assistance to Department of the Interior organizations, as well as having acted as technical consultants to a number of State governments and the Commonwealth of Puerto Rico. In addition, MAS personnel have worked closely with the private sector; this support has included providing instruction on the use of, and planning extensions to, the cost estimating system, distributing more than 3,000 copies of the "Capital and Operating Cost Estimating System Handbook," and providing nonproprietary mineral deposit data on request. A number of foreign countries have also received advice and assistance in establishing their own minerals availability programs, providing the MAS with additional contacts and sources of foreign information.

U. S. BUREAU OF MINES COST ESTIMATING SYSTEM

ESTIMATE FOR NI-CO MAS NUMBER 6410350004
EVALUATOR RGC TONS/DAY 1,800 ESCALATED TO 1979 AVG PNEWGUIN

CHAPTER 3.1 SURFACE MINING - OPERATING COSTS

ITEM NO.	ITEM DESCRIPTION	QUANTITY		LABOR COST	MATL&SUPPLY COST	EQUIP OPER COST	ITEM TOTAL
3.1.1.1	CLEARING						
3.1.1.1	EACH HECTARE PRODUCES 360 MT OF ORE SO WITH 1800 MTPD, 1800/360 = 5 H/						
3.1.1.1	DAY CLEARED.						
	CLEARING FOR SURFACE MINES	5	HA/D	4843.40	1503.41	4191.05	10537.86
3.1.1.2	DRILL & BLAST - WASTE						
3.1.1.2	ASSUME ONLY 10% IS BLASTED.						
	PERCUSSION DRILLS	3600	MTPD	140.66	124.26	97.04	361.97
3.1.1.3	EXCAVATION, LD,HAUL WASTE						
	TRUCKS AND FRONT END LOADERS	3600	MTPD	1674.62		2606.79	4281.42
3.1.1	PRODUCTION DEVELOPMENT	COST/DAY		6658.68	1627.67	6894.89	15181.25
3.1.1	PRODUCTION DEVELOPMENT	COST PER TPD		3.69	.90	3.83	8.43
3.1.2.1	DRILL AND BLAST - ORE						
3.1.2.1	ASSUME ONLY 25% IS BLASTED.						
	PERCUSSION DRILLS	1800	MTPD	199.06	181.04	138.08	518.19
3.1.2.2	EXCAVATION, LD & HAUL ORE						
	FRONT END LOADERS AND TRUCKS	1800	MTPD	1330.74		2024.07	3354.81
3.1.2	MINING OF ORE	COST/DAY		1529.80	181.04	2162.16	3873.01
3.1.2	MINING OF ORE	COST PER TPD		.84	.10	1.20	2.15
3.1.4.1	GENERAL ITEMS						
	OVER 1000 METRIC TONS/DAY	5400	MTPD	461.13	156.75	71.77	689.66
3.1.4.2	WATER SUPPLY SYSTEM						
	WATER SUPPLY SYSTEM	5400	MTPD		59.77		59.77
3.1.4.3	DRAINAGE & DISPOSAL SYSTM						
	DRAINAGE AND DISPOSAL SYSTEM	4000000	M-CU M	47.06	557.34	49.71	654.11

FIGURE 13. - Surface mining operating costs.

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APPENDIX A.--GLOSSARY

ADIT	Advanced Deposit Information Tracking system
AFOC	Alaska Field Operations Center, Juneau, Alaska
Availability	The relation between market prices and the amounts that producers could sell, given a specified price which is not an equilibrium price and has no relationship to demand.
BASIC	Beginner's all-purpose symbolic instruction code
CES	Cost estimating system
CIEP	Council on International Economic Policy
COBOL	Common business oriented computer language
DCFROR	Discounted cash flow rate of return
DFO	Division of Field Operations
DMA	Division of Minerals Availability
DMS II	Data management systems
Data Base	Compilation of data elements
EFOC	Eastern Field Operations Center, Pittsburgh, Pa.
ETD	Economic time diagram
FOC	Field Operations Center
FORTRAN	Formula translation--computer programming system
GAO	General Accounting Office
IFOC	Intermountain Field Operations Center, Denver, Colo.
MAFO	Minerals Availability Field Office, Denver, Colo.
MAS	Minerals Availability System
MASNC	MAS data base report nonconfidential
MILS	Mineral Industry Location System
MILSR	MILS printout with published reserves
MINSIM	Mine economic evaluation simulation program
Q9	MAS data base report with resource data
Reserve	That part of the reserve base which could be economically extracted or produced at the time of determination.
Resource	A concentration of naturally occurring solid, liquid, or gaseous material in or on the earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible.
SAM	Supply Analysis Model
Supply	The relation between market prices and the amount that producers are willing to produce and sell.
UTM	Universal transverse mercator
WANG VS	Computer processing unit
WFOC	Western Field Operations Center, Spokane, Wash.

APPENDIX B.--MAS DATA BASE ORGANIZATION

	Size, Characters
MILS data set:	
*SEQence number	10
#NATion	20
#STAte or political subdivision	20
#COUnty	20
IDENTification group:	
**NAMe of deposit or operation	35
**TYPe of operation	12
**CURrent status	13
LOCATion group:	
**LATitude	7
**LONgitude	8
POR Point Of Reference and precision	14
ELEvation and precision	10
DATum of elevation	9
YFC Year Field Checked	4
UTM group:	
ZONe and hemisphere	3
NORthing	7
EASting	6
TOPOGraphic group:	
QUAdrangle	18
MAP name and scale	24
DOMain	14
BASIN group:	
RIVer basin name	24
RBC River Basin Code	4
HUC Hydrologic Unit Code	8
HOLdings, mineral	41
REFERence group:	
EVAluator	10
MPF Mineral Property File	6
MMR Mine Map Repository	1
CORe library	1
MID Mines I.D	7
GSCrib	7
TOE Type of Evaluation	1
YOI Year of Information entry	4
PLANT group:	
PLT PLant Type	6
PID Plant IDentifier	6
#FOC Field Operations Center	1
#LMM Last MILS Modification	6
#LDM Last Deposit Modification	6
COMMOD Commodity data set:	
*RECord number	2
COMMOdity group:	
COMmodity name	14
MOC Modifier of Commodity	22

*Control keys.
**Required items (at least one for each sequence number).
#These items will be generated by the system at the time of update.

	Size, Characters
MARketability	1
SIC Standard Industrial Code	4
DLM Date of Last Modification	6
B Bibliography data set:	
*B-SET reference	1
*B-LINe number	3
B-BIBliography	67
C Comments data set:	
*C-SET reference	1
*C-LINe number	3
C-COMments	67
D Development schedule data set:	
*D-DEVelopment schedule	1
*D-RECord number	3
DEVELopment group:	
D-BEGinning year	4
D-ENDing year	4
D-PPY PreProduction Years	2
D-REFerence	10
D-SOUrce	2
D-MINe	2
D-METallurgy	2
D-PROducts	18
D-REMarks	30
#D-DLM Date of Last Modification	6
E Environment data set:	
ENV-group:	
E-DIStrict name	15
E-ROAd (in kilometers)	4
E-WATer (in kilometers)	4
E-POWer (in kilometers)	4
E-TOPography	8
E-RAInfall and distribution	12
E-TEMperature	4
E-VEGetation	9
ENV-2 group:	
E-SOIl texture	9
E-USE of land	11
E-WORking season	7
E-LABor supply	8
E-SENsitivity to development	16
E-SURface area potentially disturbed	5
#E-DLM Date of Last Modification	6
EQUIP Equipment-items data set:	
*EQDEVelopment schedule	1
EQLINe number	3
EQDEScription	60
EQ-1 group:	
EQSET reference	2
EQUSE	3

		Size, Characters
	EQNUMber	4
	EQPURchase year	15
	EQYOC Year of Cost	20
	EQLEX Life expectancy	3
	EQHUD Hours Used/Day	4
	EQ-2 group:	
	EQCAP	6
	EQUOC	14
	EQTIMe (in hours)	6
	EQOPC OPerating Cost units	9
	EQDOC Date of Cost	6
	EQCST EQuipment CoST (in dollars)	11
	EQDUC Date of EQCST Cost	6
	EQREMarks	60
	EQDLM Date of Last Modification	6
F	Feeds date set:	
	*F-DEVelopment schedule	1
	*F-RECord number	1
	*F-LINe number	2
	FEED group	
	F-COMmodity	10
	F-MINeral	18
	F-GRAde	5
	F-UNIts	7
	F-CONfidentiality	1
	#F-DLM Date of Last Modification	6
G	Geometry of ore body data set:	
	*G-MATrix number	1
	*G-COLumn number	1
	G-TOB Type of Ore Body	38
	G-SOB Shape of Ore Body	33
	G-ORE controls	32
	G-ORE controls	25
	GEO-1 group:	
	G-DWA Degree of Wallrock Alteration	8
	G-TWA Type of Wallrock Alteration	47
	GEO-2 group:	
	G-ADM Average Depth to Mineralization	5
	G-MDM Minimum Depth to Mineralization	5
	G-ATU Average Thickness of Unconsolidated material	4
	G-MTU Minimum Thickness of Unconsolidated material	4
	G-ALM Average Length of Mineralization	6
	G-AWM Average Width of Mineralization	6
	G-ATM Average Thickness of Mineralization	4
	G-SAD Strike And Dip of mineralized zone	8
	G-CONfidentiality	1
H	History data set:	
	HISTOry group:	
	H-DIScovery method	25
	H-YOD Year of Discovery	4
	H-YIP Year of Initial Production	4
	H-YLP Year of Last Production	4

	Size, Characters
HP Production data set (a multipleset of H):	
*HPRECord number	3
HPDEScription	40
HPHIS group:	
HPYOP Year of Production	4
HPRODuction	6
HPEXPonent	1
HPUNIts	25
HPCONfidentiality	1
HX eXploration data set (a multiple-occurring set of H):	
*HXRECord number	2
HXPLO group:	
HXMEThod employed	20
HXTENt employed	9
HXSUPport of evaluation	9
HXYOW Year Of Work	4
HXSTAtus	8
HXYOI Year Of Information	4
HXCONfidentiality	1
I Investment data set:	
*I-DEVelopment schedule	1
*I-RECord number	3
INVEStment group:	
I-SET reference	2
I-CATegory	20
I-COSt	8
I-UNIts	14
I-DOC Date of Cost	6
I-BEGinning year	4
I-ENDing year	4
I-TYPe	1
I-CONfidentiality	1
#I-DLM Date of Last Modification	6
K Concentrator data set:	
*K-DEVelopment schedule	1
*K-RECord number	1
KON-1 group:	
K-LATitude	7
K-LONgitude	8
K-PROduct	8
K-DCA Design CApacity	6
K-UOD Units of Design	14
K-DPC Design PerCent	3
K-TPU Total Percent Used	3
K-ODY Operating Days per Year	3
K-OSD Operating Shifts per Day	1
KON-2 group:	
K-PMP reference	11
K-SEQuence reference	10
K-UPC Unit Production Cost	5
K-UOP Units of Production	14

	Size, Characters
K-INVestment	6
K-METhod	14
KON-3 group:	
K-ST1 STep 1	20
K-ST2 STep 2	20
K-ST3 STep 3	20
KON-4 group:	
K-ST4 STep 4	20
K-ST5 STep 5	20
K-ST6 STep 6	20
#K-DLM Date of Last Modification	6
L Lithology data set:	
*L-MATrix	1
*L-RECord number	2
LITH1 group:	
L-FORmat name	23
L-GAF Geologic Age of Deformation	6
L-DENsity, in situ	4
L-RELation of mineralization to deformation	20
LITH2 group:	
L-DEFormation description	51
L-GAD Geologic Age of Deformation	6
*LRLINe number	2
LROCK group:	
LRNAMe	18
LRRELationship to ore	33
LA Labor-force labor data set:	
*LADEVelopment schedule	1
*LARECord number	3
LA-1 group:	
LAWCT Work CaTegory	20
LAWLC Work LoCation	10
LANUMber of daily workers in this work category and location.	3
LANMH Number of daily Man Hours in this work category and location	4
LADAY percent of workers in DAY shift	3
LASWG percent of workers in SWinG shift	3
LANIT percent of workers in NIghT shift	3
LA-2 group:	
LABASe wage of labor in this work category and location	6
LAUBW Units of Base Wage	20
LABEN percentage of BENefits above base wage	3
LADOC Date of Cost	6
LAUNIon to which labor belongs	25
#LADLM Date of Last Modification	6
M Minerals data set:	
*M-MATrix	1
*M-RECord number	2
MIN-1 group:	
M-GAM Geologic Age of Mineralization	6

		Size, Characters
	M-OGS Overall Grain Size	17
	M-NAMe of mineral	20
	MIN-2 group:	
	M-CLAss	30
	M-GRAin size	17
	M-AMOunt	4
	M-UNIts	7
N	Name data set (additional names):	
	*N-RECord number	2
	N-NAMe	35
O	Ownership data set:	
	*O-RECord number	2
	O-NAMe of owner-operator	56
	OWNER group:	
	O-STAtus of owner-operator	8
	O-PCT percent ownership	3
	O-HOMe office location	20
	O-YOI Year of Information	4
	O-CONfidentiality	1
	#O-DLM Date of Last Modification	6
P	Product data set:	
	*P-DEVelopment schedule	1
	*P-RECord number	1
	P-COMmodity	30
	P-METhod	14
	P-DE1 Product DEscription 1	20
	P-DE2 Product DEscription 2	20
	P-DE3 Product DEscription 3	20
	PRO-1 group:	
	P-CAPacity per 24 hours	6
	P-UOC Units Of Capacity	14
	P-OUTput per 24 hours	6
	P-UOO Units Of Output	14
	P-PROduct description	14
	PRO-2 group:	
	P-MATrix reference	1
	P-STAtus	8
	P-OPTion	1
	P-UPC Unit Production Cost	5
	P-UOP Units Of Production	14
	P-INVestment ($1,000)	6
	P-ODY Operating Days per Year	3
	P-OSD Operating Shifts per Day	1
	P-YOI Year Of Information	4
	P-CONfidentiality	1
	#P-DLM Date of Last Modification	6
PLS	Public Land Survey data set:	
	PLS group:	
	P-MERidian	14
	P-TWN township	5
	P-RNG range	5

	Size, Characters
P-SECtion	2
P-SUBdivision	6
P-SURvey status	6
Q Quantity data set:	
*Q-MATrix number	1
*Q-COLumn number	1
QUANTity group:	
Q-P90 Quantity Probability level 90 percent	6
Q-P75 Quantity Probability level 75 percent	6
Q-P50 Quantity Probability level 50 percent	6
Q-P25 Quantity Probability level 25 percent	6
Q-P10 Quantity Probability level 10 percent	6
Q-EXPonent	1
Q-UNIts	14
Q-CMG Classification of Minable Grades	5
Q-EVAluator	10
QUALification group:	
Q-EQUations reference	6
Q-NARrative reference	6
Q-REMarks reference	6
Q-YOI Year of Information	4
#Q-DLM Date of Last Modification	6
QA QAssay data set (a multiple set of Q):	
*QALINe number	2
QASAY group:	
QACOMmodity	10
QAMINeral	18
QAGRAde	5
QAUNIts	7
#QADLM Date of Last Modification	6
R Reserves data set:	
*R-RECord number	1
RESERve group:	
R-MEAsured	6
R-INDicated	6
R-INFerred	6
R-UNDetermined	6
R-EXPonent	1
R-UNIts	14
R-MATrix reference	1
R-COLumn reference	1
R-BIBliography reference	6
R-YOI Year Of Information	4
R-REMarks	60
#R-DLM Date of Last Modification	6
RA RAssay data set (a multiple of R):	
*RALINe number	2
RASAY group:	
RQACOMmodity	10
RAMINeral	18
RAGRAde	5

	Size, Characters
RAUNIts	7
#RADLM Date of Last Modification	6
S Surface mining data set:	
*S-DEVelopment schedule	1
*S-RECord number	1
SUR-1 group:	
S-MATrix reference	1
S-COLumn reference	1
S-ROW reference	1
S-STAtus	8
S-METhod of mining	17
S-SWEll factor	3
S-WASte rock	4
S-ACT Average Cover Thickness	4
S-COVer description and percentage	50
SUR-2 group:	
S-HARdness of ore	12
S-SURface area of mine	5
S-BENch height	3
S-SLOpe of pit	2
SUR-3 group:	
S-CAPacity	6
S-UOC Units of Capacity	14
S-PREproduction stripping volume	6
S-UPC Unit Production Cost	5
S-UOP Units Of Production	14
S-INVestment ($1,000)	6
S-ODY Operating Days per Year	3
S-OSD Operating Shifts per Day	1
S-YOI Year Of Information	4
S-CONfidentiality	1
#S-DLM Date of Last Modification	6
T Transportation data set:	
*T-DEVelopment schedule	1
*T-RECOrd number	2
TRA-1 group:	
T-SET reference	2
T-ORIgin facility	1
T-OPT Origin PoinT	20
T-OLAtitude	7
T-OLOngitude	8
T-PCT PerCenT shipped	3
TRA-2 group:	
T-DEStination facility	10
T-DPT Destination PoinT	20
T-DLAtitude	7
T-DLOngitude	8
T-ZIP code of destination	5
T-YOI Year Of Information	4
#T-DLM Date of Last Modification	6

	Size, Characters
TM Mode of transportation data set (a multiple set of T):	
*TMLINe number	1
TMODE group:	
TMTYPe of Transportation	8
TMDIStance	5
TMCOSt	5
TMUNIts	5
#TMDLM Date of Last Modification	6
U Underground mining data set:	
*U-DEVelopment schedule	1
*U-RECord number	1
UND-1 group:	
U-MATrix reference	1
U-COLumn reference	1
U-ROW reference	1
U-STAtus	8
U-METhod of mining	36
U-SWEll factor	3
U-WASte rock	4
U-PCT PerCenT recovery	3
U-HARdness and water conditions	40
U-ROCk mass characteristics	35
U-SUPport characteristics	60
UND-2 group:	
U-DOS average Depth Of Shafts	4
U-NOS Number Of Shafts	2
U-LOI average Length Of Inclines	4
U-SOI Slope Of Inclines	2
U-NOI Number Of Inclines	2
U-LOA average Length Of Adits	5
U-NOA Number Of Adits	2
U-WORkings, total	7
U-COW Condition Of Workings	47
UND-3 group:	
U-CAPacity	6
U-UOC Units Of Capacity	14
U-UPC Unit Production Cost	5
U-UOP Units Of Production	14
U-INVestment ($1,000)	6
U-ODY Operating Days per Year	3
U-OSD Operating Shifts per Day	1
U-YOI Year Of Information	4
U-CONfidentiality	1
#U-DLM Date of Last Modification	6
W Water-mining data set:	
*W-DEVelopment schedule	1
*W-RECord number	1
WAT-1 group:	
W-MATrix reference	1
W-COLumn reference	1
W-ROW reference	1
W-STAtus	8

	Size, Characters
W-METhod of mining	20
W-WASte material	4
W-SURface area of mine (square kilometers)	6
W-MSA Minable Surface Area	3
W-PCT PerCenT recovery	3
W-KSM Kilograms per Square Meter ore concentration	4
W-AST Average Sediment Thickness	4
W-SSS Sediment Shear Strength	3
W-COVer description	49
WAT-2 group:	
W-CAPacity	6
W-UOC Units Of Capacity	14
W-UPC Unit Production Cost	5
W-UOP Units Of Production	14
W-INVestment ($1,000)	6
W-ODY Operating Days per Year	3
W-OSD Operating Shifts per Day	1
W-OHD Operating Hours per Day	2
W-YOI Year Of Information	4
W-CONfidentiality	1
WAT-3 group:	
W-HARdness of ore	12
W-ACT Average Cover Thickness	4
W-PPS PreProduction Stripping volume	6
W-SWEll factor	3
W-DPF Distance to Port Facilities	5
W-WAVe height	3
W-TIDe maximum	3
W-BOTtom currents	3
W-ASF Average Storm Frequency	2
W-ASD Average Storm Duration	2
W-ENV type of ENVironmental assessment	1
W-REMarks	25
#W-DLM Date of Last Modification	6
Y Yields data set:	
*Y-DEVelopment schedule	1
*Y-RECord number	1
*Y-LINe number	2
YIELD group:	
Y-COMmodity	10
Y-MINeral	18
Y-GRAde	5
Y-UNIts	7
Y-PCT PerCenT recovery	3
Y-YOI Year of Information	4
Y-CONfidentiality	1
#Y-DLM Date of Last Modification	6

APPENDIX C.--MINSIM INPUT PARAMETERS

Category	Description
01	Exploration
02	Land acquisition
03	Mining preparation (other than equipment)
04	Investment number 1 (mine)
05	Investment number 2 (mine)
06	Investment number 3 (mine)
07	Investment number 4 (processing and infrastructure)
08	Investment number 5 (processing and infrastructure)
09	Investment number 6 (processing and infrastructure)
10	Investment number 7 (miscellaneous) (no salvage, not depreciable)
11	Loan number 1
12	Loan number 2
13	Loan number 3
14	Working capital
15	Mine operating costs per category 19 unit
16	Mill operating costs per unit processed
17	Leach operating costs per unit precipitated
18	Total overhead per unit treated
19	Units treated
20	Miscellaneous operating expenses, for example, rents
	COMMODITY NUMBER 1
21	Ore feed grade
22	Mill recovery
23	Mill concentrate grade
24	Smelter recovery
25	Smelter concentrate grade
26	Refiner recovery
	Operating costs per input unit processed
27	Smelter
28	Refiner
	Transportation costs per unit
29	To smelter
30	To refiner
31	To market
32	Price per unit recovered
	COMMODITY NUMBER 2
33	Ore feed grade
34	Mill recovery
35	Mill concentrate grade
36	Smelter recovery
37	Smelter concentrate grade
38	Refiner recovery
	Operating costs per input unit processed
39	Smelter
40	Refiner

Category	Description
	Transportation costs per unit
41	To smelter
42	To refiner
43	To market
44	Price per unit recovered
	COMMODITY NUMBER 3
45	Ore feed grade
46	Mill recovery
47	Mill concentrate grade
48	Smelter recovery
49	Smelter concentrate grade
50	Refiner recovery
	Operating costs per input unit processed
51	Smelter
52	Refiner
	Transportation costs per unit
53	To smelter
54	To refiner
55	To market
56	Price per unit recovered
	COMMODITY NUMBER 4
57	Ore feed grade
58	Mill recovery
59	Mill concentrate grade
60	Smelter recovery
61	Smelter concentrate grade
62	Refiner recovery
	Operating costs per input unit processed
63	Smelter
64	Refiner
	Transportation costs per unit
65	To smelter
66	To refiner
67	To market
68	Price per unit recovered
	COMMODITY NUMBER 5
69	Ore feed grade
70	Mill recovery
71	Mill concentrate grade
72	Smelter recovery
73	Smelter concentrate grade
74	Refiner recovery

Category	Description
	Operating costs per input unit processed
75	Smelter
76	Refiner
	Transportation costs per unit
77	To smelter
78	To refiner
79	To market
80	Price per unit recovered
	LEACH COMMODITY
81	Precipitate grade
82	Units precipitated
83	Smelter recovery
84	Smelter concentrate grade
85	Refiner recovery
	Operating costs per input unit processed
86	Smelter
87	Refiner
	Transportation
88	To smelter
89	To refiner
90	To market
91	Name and parameters for commodity number 1
92	Name and parameters for commodity number 2
93	Name and parameters for commodity number 3
94	Name and parameters for commodity number 4
95	Name and parameters for commodity number 5
96	Royalty parameters
97	Tax records
98	Depletion allowance options
99	Record ignored by program

APPENDIX D.--MAS DATA BASE PRINTOUT

U.S. Bureau of Mines Minerals Availability System

This information is from a working file of the U.S. Bureau of Mines Minerals Availability System. Quality of the information can range from preliminary, unconfirmed data to validated assessments. This information is for use and further review within the U.S. Bureau of Mines and by specialists in relevant disciplines in other organizations. Owing to the preliminary status of some of the contained data, caution should be exercised in its use. For further information, comments or corrections, please contact the Minerals Availability Field Office, Bldg. 20, Denver Federal Center, Denver, CO 80225, telephone (303) 234-6266.

DATE PRINTED: APR 02, 1982

MINERALS AVAILABILITY SYSTEM
DEPOSIT LISTING

PAGE 1

DEPOSIT NAME: LAKESHORE

SEQUENCE NUMBER: 9999990000

>>>> MILS - DATA SET <<<<
(MINERAL INDUSTRY LOCATION)

STATE: MAFO
COUNTY:
TYPE OF OPERATION: SURF-UNDERG
CURRENT STATUS: DEVEL DEPOSIT
LATITUDE: N 32DEG 36MIN 15SEC
LONGITUDE: W 112DEG 08MIN 29SEC
UTM - ZONE: 12
HEMISPHERE: NORTHERN
NORTHING: 3607791
EASTING: 392897
POINT OF REFERENCE: ORE BODY
PRECISION: 1 KILOMETERS
ELEVATION: 579 METERS
PRECISION: 100 METERS
EVALUATOR: MKNY

MINE MAP REPOSITORY:
QUADRANGLE:
RIVER BASIN NAME:
SANTA ROSA WASH
RIVER BASIN CODE: 60H
HYDROLOGIC UNIT CODE:
DATUM OF ELEVATION: SEA LEVEL
MAP NAME:
SCALE:
DOMAIN:
TYPE OF MINERAL HOLDINGS:
PRIVATE LEASE

TYPE OF EVALUATION: C

TYPE OF PLANT:
PLANT IDENTIFIER:
YEAR FIELD CHECKED:
YEAR OF INFORMATION ENTRY: 1972
MAINTAINING FIELD CENTER:

MINERAL PROPERTY FILE:
CORE LIBRARY:
MINES IDENTIFICATION:
GEOLOGICAL SURVEY CRIB:
LAST MILS MODIFICATION:
OCT 24, 1979
LAST DEPOSIT MODIFICATION:
OCT 24, 1979

--PUBLIC LAND SURVEY--

PRINCIPAL MERIDIAN:
GILA & SALT R
TOWNSHIP: 010 S
RANGE: 004 E
SECTION: 36
SECTION SUBDIVISION:
, ,
SURVEY STATUS: UNK

>>>> COMMODITY - DATA SET <<<<

RECORD NO.	COMMODITY	MODIFIER	MARKETABILITY	STANDARD INDUSTRIAL CODE	DATE OF LAST MODIFICATION
01	COPPER	SULFIDE	RECOVERABLE		OCT 24, 1979
02	COPPER	OXIDE	RECOVERABLE		OCT 24, 1979
03	COPPER	SULFIDE	RECOVERABLE		OCT 24, 1979
04	MOLYBDENUM		RECOVERABLE		OCT 24, 1979
05	GOLD		RECOVERABLE		OCT 24, 1979
06	SILVER		RECOVERABLE		OCT 24, 1979

>>>> OWNERSHIP - DATA SET <<<<

RECORD NO.	NAME OF OWNER	STATUS	PERCENT OF OWNERSHIP	LOCATION OF HOME OFFICE	YEAR OF INFORM.	DATE OF LAST MODIFICATION
01	HECLA MINING CO.	OWNER-OPERATOR	050 %	USA IDAHO	1973	OCT 24, 1979
02	EL PASO NATURAL GAS CO.	OWNER	050 %	USA TEXAS	1973	OCT 24, 1979

%

DEPOSIT NAME: LAKESHORE

SEQUENCE NUMBER: 9999990000

>>>> PUBLISHED RESERVES/RESOURCES <<<<
QUANTITY (NONCUMULATIVE) AND GRADE

RESERVES	REC 1	REC 2	REC 3	REC 4	REC 5	REC 6	REC 7	REC 8	REC 9
MEASURED		218587	187749	21405					
INDICATED		218587	187749	21405					
INFERRED		218587	187749	21405					
**UNDETERMINED		218587	187749	21405					
*EXPONENT		3	3	3					
UNITS		MT ORE	MT ORE	MT ORE					
MATRIX REF.									
COLUMN REF.									
YEAR OF INFO		1970	1970	1970					
DATE OF LAST MODIFICATION		791024	791024	791024					

*ALL QUANTITIES ARE EXPRESSED TIMES 10 TO THIS POWER FOR A GIVEN COLUMN.
**UNIDENTIFIABLE AS MEASURED, INDICATED, OR INFERRED

UNITS -- TABLE

CON = CONCENTRATE
COM = COMMODITY
MT = METRIC TONS
M3 = CUBIC METERS ORE

GRADE ASSAY/FORM	REC 1	REC 2	REC 3	REC 4	REC 5	REC 6	REC 7	REC 8	REC 9	GRADE UNITS	MINERAL	DATE OF LAST MODIFICATION	LINE NO.

RESERVES - REMARKS

DATE PRINTED: APR 02, 1982

MINERALS AVAILABILITY SYSTEM
DEPOSIT LISTING

DEPOSIT NAME: LAKESHORE

SEQUENCE NUMBER: 9999990000

>>>> QUANTITY - RESOURCES <<<<
QUANTITY (CUMULATIVE) AND GRADE -

MATRIX = 1

QUANTITY	COL 1	COL 2	COL 3	COL 4	COL 5	COL 6	COL 7	COL 8	COL 9
AT 90 PERCENT	21405								
AT 75 PERCENT	32107								
AT 50 PERCENT	42810								
AT 25 PERCENT	42810								
AT 10 PERCENT	42810								
*EXPONENT	3								
UNITS	MT ORE								
Q-CMG									
EVALUATOR	MKNY								
YEAR OF INFO	1970								
DATE OF LAST MODIFICATION	791024								

*ALL QUANTITIES ARE EXPRESSED TIMES 10 TO THIS POWER FOR A GIVEN COLUMN.

GRADE ASSAY/FORM	COL 1	COL 2	COL 3	COL 4	COL 5	COL 6	COL 7	COL 8	COL 9	GRADE UNITS	MINERAL	DATE OF LAST MODIFICATION	LINE NO.

UNITS -- TABLE
CON = CONCENTRATE
COM = COMMODITY
MT = METRIC TONS
M3 = CUBIC METERS ORE

%

DEPOSIT NAME: LAKESHORE

SEQUENCE NUMBER: 9999990000

>>>> QUANTITY - RESOURCES <<<<
QUANTITY (CUMULATIVE) AND GRADE

MATRIX = 2

QUANTITY	COL 1	COL 2	COL 3	COL 4	COL 5	COL 6	COL 7	COL 8	COL 9
AT 90 PERCENT	187749								
AT 75 PERCENT	281623								
AT 50 PERCENT	375498								
AT 25 PERCENT	375498								
AT 10 PERCENT	375498								
*EXPONENT	3								
UNITS	MT ORE								
Q-CMG									
EVALUATOR	MKNY								
YEAR OF INFO	1970								
DATE OF LAST MODIFICATION	791024								

U N I T S -- T A B L E
CON = CONCENTRATE
COM = COMMODITY
MT = METRIC TONS
M3 = CUBIC METERS ORE

*ALL QUANTITIES ARE EXPRESSED TIMES 10 TO THIS POWER FOR A GIVEN COLUMN.

GRADE ASSAY/FORM	COL 1	COL 2	COL 3	COL 4	COL 5	COL 6	COL 7	COL 8	COL 9	GRADE UNITS	MINERAL	DATE OF LAST MODIFICATION	LINE NO.

%

DATE PRINTED: APR 02, 1982

MINERALS AVAILABILITY SYSTEM
DEPOSIT LISTING

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DEPOSIT NAME: LAKESHORE

SEQUENCE NUMBER: 9999990000

>>>> QUANTITY - RESOURCES <<<<
QUANTITY (CUMULATIVE) AND GRADE-

MATRIX = 3

QUANTITY	COL 1	COL 2	COL 3	COL 4	COL 5	COL 6	COL 7	COL 8	COL 9
AT 90 PERCENT	218587								
AT 75 PERCENT	327880								
AT 50 PERCENT	437174								
AT 25 PERCENT	437174								
AT 10 PERCENT	437174								
*EXPONENT	3								
UNITS	MT ORE								
Q-CMG									
EVALUATOR	MKNY								
YEAR OF INFO	1970								
DATE OF LAST MODIFICATION	791024								

*ALL QUANTITIES ARE EXPRESSED TIMES 10 TO THIS POWER FOR A GIVEN COLUMN.

UNITS -- TABLE
CON = CONCENTRATE
COM = COMMODITY
MT = METRIC TONS
M3 = CUBIC METERS ORE

GRADE ASSAY/FORM	COL 1	COL 2	COL 3	COL 4	COL 5	COL 6	COL 7	COL 8	COL 9	GRADE UNITS	MINERAL	DATE OF LAST MODIFICATION	LINE NO.

%

DEPOSIT NAME: LAKESHORE SEQUENCE NUMBER: 9999990000

>>>> DEVELOPMENT - DATA SET <<<<

DEVELOPMENT SCHEDULE: 1

REC NO.	BEGINNING YEAR	ENDING YEAR	PREPROD YEARS	REFERENCE	SOURCE	MINE	METALLURGY	PRODUCTS	REMARKS	DATE OF LAST MODIFICATION
001				0040219999	Q1	U1	K1	PA	D FROM TRANSLATOR	OCT 24, 1979
002				0040219999	Q2	U2	K2	PG	D FROM TRANSLATOR	OCT 24, 1979
003				0040219999	Q3	U3	K3	PM	D FROM TRANSLATOR	OCT 24, 1979

>>>> INVESTMENT <<<<

RECORD NO.	SET ID	CATEGORY		COST	UNITS	DATE OF COST	BEGINNING YEAR	ENDING YEAR	TYPE	DATE OF LAST MODIFICATION
001	U1	MINE CAP TOTAL	$	44319	DOLLARS X 1000	70			PROPOSED	OCT 24, 1979
002	U1	MINE OP COST	$	2.464	$/MT ORE	70			PROPOSED	OCT 24, 1979
003	PA	CIRCUIT CAP TOTAL	$	21260	DOLLARS X 1000	70			PROPOSED	OCT 24, 1979
004	PA	CIRCUIT OP COST	$	1.021	$/MT ORE	70			PROPOSED	OCT 24, 1979
005	U2	MINE CAP TOTAL	$	.00001	DOLLARS X 1000	70			PROPOSED	OCT 24, 1979
006	U2	MINE OP COST	$	2.464	$/MT ORE	70			PROPOSED	OCT 24, 1979
007	PG	CIRCUIT CAP TOTAL	$	12661	DOLLARS X 1000	70			PROPOSED	OCT 24, 1979
008	PG	CIRCUIT OP COST	$	1.220	$/MT ORE	70			PROPOSED	OCT 24, 1979
009	U3	MINE CAP TOTAL	$	.00001	DOLLARS X 1000	70			PROPOSED	OCT 24, 1979
010	U3	MINE OP COST	$	2.464	$/MT ORE	70			PROPOSED	OCT 24, 1979
012	PM	CIRCUIT OP COST	$	1.021	$/MT ORE	70			PROPOSED	OCT 24, 1979

>>>>>>>>>>>>>>>> UNDERGROUND - DATA SET <<<<<<<<<<<<<<<

DEVELOPMENT SCHEDULE: 1
MINING RECORD NUMBER: 1 MATRIX: 1COLUMN: 1 ROW: 2

DATA ON THIS RECORD IS: PROPOSED
METHOD OF MINING: BLOCK CAVING 10-79
SWELL FACTOR: .75
WASTE ROCK: 5.0 PERCENT
PERCENT OF RECOVERY:
HARDNESS AND WATER CONDITIONS:
HARDROCK WITH LITTLE WATER
ROCK MASS CHARACTERISTICS: ONE SYSTEM OF WEAKNESS PLANES
SUPPORT CHARACTERISTICS:
SUPPORTING MAY BACK SLAB POST, HEADBOARD, CAPS, ROOF BOLTS
SHAFTS: AVERAGE DEPTH (IN METERS) - NO. -
INCLINES: AVERAGE LENGTH (IN METERS) - 2286 NO. - 2 SLOPE: 15 DEGREES
ADITS: AVERAGE LENGTH - NO. -

TOTAL WORKINGS:
CONDITION OF WORKINGS
UNKNOWN
CAPACITY: 9977
UNITS OF CAPACITY: MT ORE/DAY
UNIT PRODUCTION COST: $ 2.464
PRODUCTION UNITS: $/MT ORE
INVESTMENT: $ 44319 X 1000
OPERATING DAYS PER YEAR: 357
SHIFTS PER DAY: 3
YEAR OF INFORMATION: 1970
DATE OF LAST MODIFICATION: OCT 24, 1979

%

MINERALS AVAILABILITY SYSTEM
DEPOSIT LISTING

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DEPOSIT NAME: LAKESHORE SEQUENCE NUMBER: 9999990000

>>>>>>>>>>>>>>>> UNOERGROUND - OATA SET <<<<<<<<<<<<<<<

OEVELOPMENT SCHEDULE: 1
MINING RECORD NUMBER: 2 MATRIX: 2COLUMN: 1 ROW: 2

OATA ON THIS RECORO IS: PROPOSEO
METHOD OF MINING: BLOCK CAVING 10-79
SWELL FACTOR: .75
WASTE ROCK: 5.0 PERCENT
PERCENT OF RECOVERY:
HARDNESS AND WATER CONOITIONS:
HARDROCK WITH LITTLE WATER
ROCK MASS CHARACTERISTICS: ONE SYSTEM OF WEAKNESS PLANES
SUPPORT CHARACTERISTICS:
SUPPORTING MAY BACK SLAB POST, HEADBOARD, CAPS, ROOF BOLTS
SHAFTS: AVERAGE OEPTH (IN METERS) - NO. -
INCLINES: AVERAGE LENGTH (IN METERS) - NO. - SLOPE: DEGREES
ADITS: AVERAGE LENGTH - NO. -

TOTAL WORKINGS:
CONDITION OF WORKINGS

CAPACITY: 5850
UNITS OF CAPACITY: MT ORE/DAY
UNIT PRODUCTION COST: $ 2.464
PRODUCTION UNITS: $/MT ORE
INVESTMENT: $ .00001 X 1000
OPERATING OAYS PER YEAR: 357
SHIFTS PER DAY: 3
YEAR OF INFORMATION: 1970
DATE OF LAST MODIFICATION: OCT 24, 1979

>>>>>>>>>>>>>>>> UNDERGROUNO - OATA SET <<<<<<<<<<<<<<<

OEVELOPMENT SCHEDULE: 1
MINING RECORD NUMBER: 3 MATRIX: 3COLUMN: 1 ROW: 2

OATA ON THIS RECORO IS: PROPOSEO
METHOD OF MINING: BLOCK CAVING 10-79
SWELL FACTOR: .75
WASTE ROCK: 5.0 PERCENT
PERCENT OF RECOVERY:
HARONESS ANO WATER CONDITIONS:
HARDROCK WITH LITTLE WATER
ROCK MASS CHARACTERISTICS: ONE SYSTEM OF WEAKNESS PLANES
SUPPORT CHARACTERISTICS:
SUPPORTING MAY BACK SLAB POST, HEAOBOARD, CAPS, ROOF BOLTS
SHAFTS: AVERAGE OEPTH (IN METERS) - NO. -
INCLINES: AVERAGE LENGTH (IN METERS) - NO. - SLOPE: DEGREES
ADITS: AVERAGE LENGTH - NO. -

TOTAL WORKINGS:
CONDITION OF WORKINGS

CAPACITY: 9977
UNITS OF CAPACITY: MT ORE/DAY
UNIT PROOUCTION COST: $ 2.464
PRODUCTION UNITS: $/MT ORE
INVESTMENT: $ .00001 X 1000
OPERATING DAYS PER YEAR: 357
SHIFTS PER DAY: 3
YEAR OF INFORMATION: 1970
DATE OF LAST MODIFICATION: OCT 24, 1979

>>>>>>>>>>>>>>>> CONCENTRATOR - DATA SET <<<<<<<<<<<<<<<

DEVELOPMENT SCHEOULE: 1 MILL RECORD NUMBER: 1

LATITUOE: N323615
LONGITUOE: W1120829
PRODUCT: A
OESIGN CAPACITY: 9977
UNITS OF OESIGN: MT ORE/OAY
METHOD: 5-FLOTATION

OEPOSIT PERCENT: 100
TOTAL PERCENT USED:
OPERATING OAYS PER YEAR:
SHIFTS PER OAY:
POST MINE PROCESSING
REFERENCE NO.

SEQUENCE REFERENCE:
UNIT PRODUCTION COST: $
UNITS OF PROOUCTION:
INVESTMENT:
DATE OF LAST MODIFICATION:
OCT 24, 1979

STEP 1: K FROM TRANSLATOR
2:
3:
4:
5:
6:

%

DEPOSIT NAME: LAKESHORE SEQUENCE NUMBER: 9999990000

>>>>>>>>>>>>>>> CONCENTRATOR - DATA SET <<<<<<<<<<<<<<<

DEVELOPMENT SCHEDULE: 1 MILL RECORD NUMBER: 2

LATITUDE: N323615
LONGITUDE: W1120829
PRODUCT: G
DESIGN CAPACITY: 5850
UNITS OF DESIGN: MT ORE/DAY
METHOD: 6-HYDROMET

DEPOSIT PERCENT: 100
TOTAL PERCENT USED:
OPERATING DAYS PER YEAR:
SHIFTS PER DAY:
POST MINE PROCESSING
REFERENCE NO.

SEQUENCE REFERENCE:
UNIT PRODUCTION COST: $
UNITS OF PRODUCTION:
INVESTMENT:
DATE OF LAST MODIFICATION:
OCT 24, 1979

STEP 1: K FROM TRANSLATOR
2:
3:
4:
5:
6:

>>>>>>>>>>>>>>> CONCENTRATOR - DATA SET <<<<<<<<<<<<<<<

DEVELOPMENT SCHEDULE: 1 MILL RECORD NUMBER: 3

LATITUDE: N323615
LONGITUDE: W1120829
PRODUCT: M
DESIGN CAPACITY: 9977
UNITS OF DESIGN: MT ORE/DAY
METHOD: 5-FLOTATION

DEPOSIT PERCENT: 100
TOTAL PERCENT USED:
OPERATING DAYS PER YEAR:
SHIFTS PER DAY:
POST MINE PROCESSING
REFERENCE NO.

SEQUENCE REFERENCE:
UNIT PRODUCTION COST: $
UNITS OF PRODUCTION:
INVESTMENT:
DATE OF LAST MODIFICATION:
OCT 24, 1979

STEP 1: K FROM TRANSLATOR
2:
3:
4:
5:
6:

>>>>>>>>>>>>>>>>> PRODUCT - DATA SET <<<<<<<<<<<<<<<<<

DEVELOPMENT SCHEDULE: 1 PRODUCT RECORD IDENTIFIER: A

MARKETABLE COMMODITY RECORD #:
01
METHOD: 5-FLOTATION

DESCRIPTION 1: P FROM TRANSLATOR
2:
3:

CAPACITY: 9977
UNITS: MT ORE/DAY
OUTPUT: 154
UNITS OF OUTPUT:
MT CONC/DAY
PRODUCT DESCRIPTION:

MATRIX REFERENCE: 1
MILL PRODUCTION STATUS: PROPOSED
COST OPTION: 3 -
RELATED TO PRODUCT BENEFICIATION
EXCEPT THOSE CODED OPTION 1.
UNIT PRODUCTION COST: $ 1.021
PRODUCTION UNITS: $/MT ORE

INVESTMENT: $ 21260 X 1000
OPERATING
DAYS PER YEAR:
SHIFTS PER DAY:
YEAR OF INFORMATION: 1970
DATE OF LAST
MODIFICATION: OCT 24, 1979

>>>> PRODUCT TRANSPORTATION <<<<

REC NO.	>> ORIGIN << FACILITY	ORIGIN POINT	LAT	LON	PCT	>> DESTINATION << FACILITY	DESTINATION POINT	LAT	LON	ZIP	AS OF YEAR	DATE OF LAST MODIFICATION
11	MILL (ON)	LAKSHR	N323615	W1120829	100	MARKET	STHWIR				1970	OCT 24, 1979

MODE/DISTANCE (IN KILOMETERS)

REC NO.	LINE NO.	TYPE OF TRANSPORTATION	DISTANCE: COST	UNITS	DLM
11	1	RAIL	3300 $	$/KM/	791024

x

MINERALS AVAILABILITY SYSTEM
DEPOSIT LISTING

DATE PRINTED: APR 02, 1982 PAGE 9

DEPOSIT NAME: LAKESHORE SEQUENCE NUMBER: 9999990000

>>>>>>>>>>>>>>>>> PRODUCT - DATA SET <<<<<<<<<<<<<<<<<

DEVELOPMENT SCHEDULE: 1 PRODUCT RECORD IDENTIFIER: G

MARKETABLE COMMODITY RECORD #:
02
METHOD: 6-HYDROMET

DESCRIPTION 1: P FROM TRANSLATOR
2:
3:

CAPACITY: 5850
UNITS: MT ORE/DAY
OUTPUT: 54
UNITS OF OUTPUT:
MT CONC/DAY
PRODUCT DESCRIPTION:

MATRIX REFERENCE: 2
MILL PRODUCTION STATUS: PROPOSED
COST OPTION: 1 -
RELATED TO PRODUCT BENEFICIATION
DESCRIBED IN THIS RECORD.
UNIT PRODUCTION COST: $ 1.220
PRODUCTION UNITS: $/MT ORE

INVESTMENT: $ 12661 X 1000
OPERATING
DAYS PER YEAR:
SHIFTS PER DAY:
YEAR OF INFORMATION: 1970
DATE OF LAST
MODIFICATION: OCT 24, 1979

>>>> PRODUCT TRANSPORTATION <<<<

REC NO.* FACILITY	>> ORIGIN << ORIGIN POINT	LAT	LON	PCT*	* FACILITY	>> DESTINATION << DESTINATION POINT	LAT	LON	ZIP	*AS OF: *YEAR	DATE OF LAST MODIFICATION
21 *MILL (ON)	LAKSHR	N323615	W1120829	100	*MARKET	STHWIR				*1970	OCT 24, 1979

REC NO.	LINE NO.	TYPE OF TRANSPORTATION	DISTANCE	COST	UNITS	DLM
21	1	TRUCK	45	$	$/KM/	791024
21	2	RAIL	80	$	$/KM/	791024

MODE/DISTANCE (IN KILOMETERS)

>>>>>>>>>>>>>>>>> PRODUCT - DATA SET <<<<<<<<<<<<<<<<<

DEVELOPMENT SCHEDULE: 1 PRODUCT RECORD IDENTIFIER: M

MARKETABLE COMMODITY RECORD #:
03
METHOD: 5-FLOTATION

DESCRIPTION 1: P FROM TRANSLATOR
2:
3:

CAPACITY: 9977
UNITS: MT ORE/DAY
OUTPUT: 64
UNITS OF OUTPUT:
MT COMMOD/DAY
PRODUCT DESCRIPTION:

MATRIX REFERENCE: 3
MILL PRODUCTION STATUS: PROPOSED
COST OPTION: 4 -
RELATED TO PRODUCT BENEFICIATION
OF ANOTHER RECORD WITH OPTION 3.
UNIT PRODUCTION COST: $ 1.021
PRODUCTION UNITS: $/MT ORE

INVESTMENT:
OPERATING
DAYS PER YEAR:
SHIFTS PER DAY:
YEAR OF INFORMATION: 1970
DATE OF LAST
MODIFICATION: OCT 24, 1979

%

DEPOSIT NAME: LAKESHORE SEQUENCE NUMBER: 9999990000

>>>> PRODUCT TRANSPORTATION <<<<

REC NO.	FACILITY	>> ORIGIN << ORIGIN POINT	LAT	LON	PCT	FACILITY	>> DESTINATION << DESTINATION POINT	LAT	LON	ZIP	AS OF YEAR	DATE OF LAST MODIFICATION
31	MILL (ON)	LAKSHR	N323615	W1120829	100	MARKET	STHWIR				1970	OCT 24, 1979

MODE/DISTANCE (IN KILOMETERS)

REC NO.	LINE NO.	TYPE OF TRANSPORTATION	DISTANCE	COST	UNITS	DLM
31	1	RAIL	3300	$	$/KM/	791024

>>>> ENVIRONMENT - DATA SET <<<<

MINING DISTRICT: CASA GRANDE
*DISTANCE OF ROAD NEEDED: <100
*DISTANCE TO ADEQUATE WATER SUPPLY: SITE
*DISTANCE TO ADEQUATE ELECTRICAL POWER SUPPLY:
TOPOGRAPHY: ROLLING
ANNUAL PRECIPITATION (IN CENTIMETERS) AND DISTRIBUTION: 20:WINTER
CLIMATE: TEMP
VEGETATION: DESERT
SOIL TEXTURE: UNKNOWN
PRIMARY LAND USE: GRAZING
WORKING SEASON: ALL YR
LABOR AVAILABILITY: UNSKIL

*(IN KILOMETERS)

--ENVIRONMENTAL SENSITIVITY TO MINERAL EXTRACTION--

	SHORT TERM	LONG TERM
LAND:	INSIGNIFICANT	INSIGNIFICANT
VEGETATION:	NIL	NIL
WILDLIFE:	NIL	NIL
WATER:	UNDETERMINED	UNDETERMINED
AIR:	NIL	NIL
AESTHETICS:	MODERATE	MODERATE
SOUND:	NIL	NIL
OVERALL:	INSIGNIFICANT	INSIGNIFICANT

MAXIMUM SURFACE AREA POTENTIALLY DISTURBED (HECTARES):
DATE OF LAST MODIFICATION: OCT 24, 1979

>>>> HISTORY - DATA SET <<<<

DISCOVERY METHOD: GEOLOGICAL INFERENCE
YEAR OF DISCOVERY: 1966
YEAR OF INITIAL PRODUCTION:
YEAR OF LAST PRODUCTION:

>>>> HISTORY OF EXPLORATION <<<<

RECORD NO.	METHOD EMPLOYED	EXTENT EMPLOYED	SUPPORT OF EVALUATION	YEAR OF WORK	STATUS	YEAR OF INFORMATION
01	CORE DRILLING	EXTENSIVE		1967		1972

*

MINERALS AVAILABILITY SYSTEM
DEPOSIT LISTING

DATE PRINTED: APR 02, 1982 PAGE 11

DEPOSIT NAME: LAKESHORE SEQUENCE NUMBER: 9999990000

>>>> GEOMETRY - DATA SET <<<<

MATRIX NUMBER: COLUMN NUMBER:

TYPE OF ORE BODY: STOCKWORK :DISSEMINATED
MODE OF ORIGIN: CONT METASOMATIC
SHAPE OF ORE BODY: MASSIVE
ORE CONTROLS: IGNEOUS :LITHOLOGY
DEGREE OF WALLROCK ALTERATION:
TYPE OF WALLROCK ALTERATION:

DEPTH TO MINERALIZATION (IN METERS)
AVERAGE: 150 MINIMUM: 61
THICKNESS OF UNCONSOLIDATED MATERIAL (IN METERS)
AVERAGE: MINIMUM: 5
AVERAGE DIMENSIONS OF MINERALIZATION (IN METERS)
LENGTH: 1200 WIDTH: 900 THICKNESS: 330
STRIKE AND DIP OF MINERALIZED ZONE: S11W:65W

>>>> LITHOLOGY - DATA SET <<<<

MATRIX NUMBER: RECORD NUMBER: 0

FORMATION NAME: IGNEOUS INTRUSV
AGE OF FORMATION: U CRET
DENSITY (IN SITU): 02.6

RELATIONSHIP OF MINERALIZATION TO DEFORMATION: MIN PRECEDING DEF
DEFORMATION DESCRIPTION: FAULTING
AGE OF DEFORMATION: PALEOC

>>>> ROCK - DATA SET <<<<

LINE NO.	ROCK NAME	RELATIONSHIP TO ORE
01	ANDESITE	ORE IN FRACTURES:GANGUE
02	QUARTZ MONZONITE	ORE IN FRACTURES:GANGUE
03	DIABASE	ORE IN FRACTURES:GANGUE

>>>> MINERALS - DATA SET <<<<

MAT #	REC NO.	AGE OF MINERALIZATION	OVERALL GRAIN SIZE	NAME	CLASS	GRAIN SIZE	AMOUNT	UNITS
	01	PALEOC	VARIABLE	CHALCOPYRITE	SULFIDES	VARIABLE	0054	VOL-PCT
	02	PALEOC	VARIABLE	CHRYSOCOLLA	SILICATES	VARIABLE	0046	VOL-PCT
	03	PALEOC	VARIABLE	CUPRITE	OXIDES (EXCLUDING SIO2)	VARIABLE		VOL-PCT
	04	PALEOC	VARIABLE	COVELLITE	SULFIDES			VOL-PCT

>>>> COMMENTS - DATA SET <<<<

SET REFERENCE LINE NO.	
001	REC-101 EST LIFE- 8 YR (COL 1, ROW 2 & PLNT CAPY ON REC-151).
002	(TACTITE) 90% RCVRY. PROB- 90% X 1.5 = 75%
003	FOLLOWD BY LO-GRD SULF. 90% X 2.0 = 50%-25%-10%.
004	REC-120 BASE YR 1970 FOR MINING. 4 YR PREPRODUCTION.
005	MINE CAP COSTS (1970 DLLR VALUES) TOTAL 44,318,700
006	ACQ 361,000
007	EXPL 3,522,000

%

>>>> COMMENTS - CONTINUED <<<<

SET REFERENCE	LINE NO.	
	008	DEVL 18,491,900
	009	EQPT 6,498,900
	010	PLNT 11,234,000
	011	W.C. 4,210,900
	012	MINE OP COST $2.462/TONNE
	013	CAP COST INCLUDES TACTITE,OXIDE & SULFIDE.
REC-151	014	BASE YR 1970 FOR MILLING.
	015	MILL CAP COSTS (1970 DLLR VALUES) TOTAL 21,259,700
	016	PLNT & EQPT 20,183,800
	017	W.C. 1,075,900
	018	MILL OP COST $1.021/TONNE. PROCESSING TO CATHODE CU
	019	ADDS $0.095/LB CU (INCLUDES PLNT CAP COST $41,020,000-1970
	020	DLLR VALUES- OP COST & PROFIT ON CAPITAL).
REC-202	022	EST LIFE- 91 YR (ASSUME TO LAST LIFE OF TACTITE & SULF).
	023	(OXIDE) 90% RCVRY.
	024	MINED AT SAME TIME AS TACTITE & SULF.
REC-220	025	BASE YR 1970 FOR MINING. 4 YR PREPRODUCTION.
	026	MINE CAP COSTS INCLUDED WITH REC-120
	027	TOTAL (CODED .00001)
	028	MINE OP COST $2.464/TONNE
REC-252	029	BASE YR 1970 FOR VAT LEACHING.
	030	LEACH CAP COSTS (1970 DLLR VALUES) TOTAL 12,661,000
	031	PLNT & EQPT 11,607,400
	032	W.C. 1,053,600
	033	LEACH OP COST $1.220/TONNE (INCREASES BY 30% AFTER
	034	15 YR DUE TO OLD MILL).
	035	LEACH RCVRY ASSUMED SAME AS SULFIDE.
	036	CONC GRD ASSUMD 70%.
REC-303	037	EST LIFE- 83 YR (COL 1, ROW 2 & PLNT CAPY ON REC-353).
	038	(SULFIDE) 90% RCVRY. PROB- 90% X 1.5 = 75%
	039	FOLLOWS TACTITE 90% X 2.0 = 50%-25%-10%
REC-320	040	BASE YR 1970 FOR MINING.
	041	MINE CAP COSTS INCLUDED WITH REC-120
	042	TOTAL (CODED .00001)
	043	MINE OP COST $2.464/TONNE
REC-353	044	BASE YR 1970 FOR MILLING.
	045	MILL CAP COSTS INCLUDED WITH REC-151
	046	TOTAL NO ENTRY
	047	MILL OP COST $1.021/TONNE. PROCESSING TO CATHODE CU
	048	ADDS $0.095/LB CU (INCLUDES PLNT CAP COST $41,020,000-1970
	049	DLLR VALUES- OP COST & PROFIT ON CAPITAL).
	051	(MILL OP COST INCREASES BY 30% AFTER
	052	7 YR DUE TO OLD MILL).
REC-160	053	CATHODE TO SOUTHWIRE,GA FOR FABRICATING.
REC-260	054	CEMENT CU TO HAYDEN,AZ FOR SMELT & REFINE.
REC-360	055	CATHODE TO SOUTHWIRE,GA FOR FABRICATING.
	056	ROYALTY ON THIS PROPERTY IS 10% OF SALE OF SMELTED CU (ACCORDING TO

%

BD-23

306

>>>> COMMENTS - CONTINUED <<<<

SET REFERENCE	LINE NO.	
	057	PAYDIRT 9/20/69.

>>>> BIBLIOGRAPHY - DATA SET <<<<

SET REFERENCE	LINE NO.	
	001	PAYDIRT 4/26/71 (NO. OF INCLINES & LENGTH).
	002	E.& M.J. 6/69 (TONS & GRADE).
	003	PAYDIRT 3/70 (MO,AG,AU QNTY EST).
	004	C.I.M. BULL 5/73 PP 48-56 (ROAST,LEACH,ELECTROWIN COSTS).